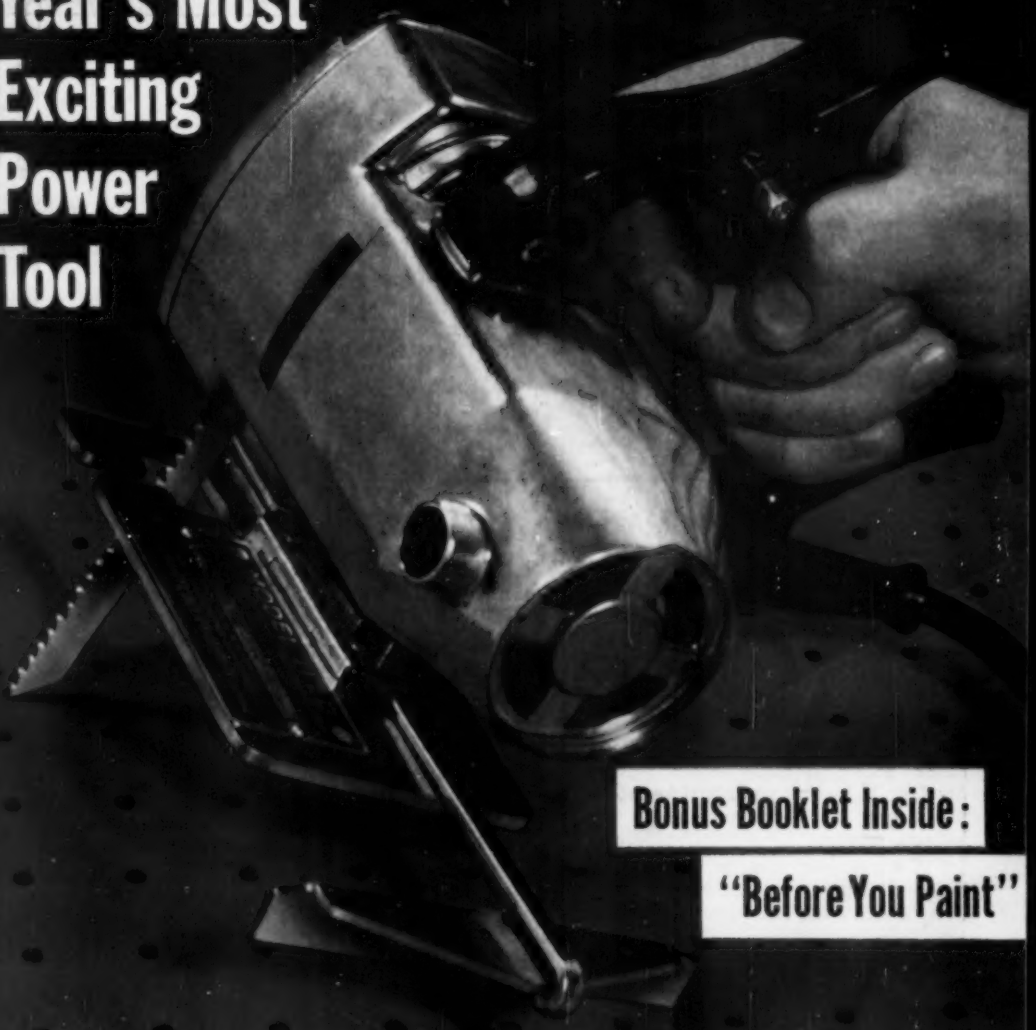
POPULAR SCIENCE

MARCH · 35c *Monthly*

Electric handsaw:

Year's Most Exciting Power Tool



Bonus Booklet Inside:

"Before You Paint"

WIN

the boat and motor of your dreams in Evinrude's

dreamboat contest

FEB. 22 - MAR. 23

choose from the boats and motors on display at your

EVINRUDE DEALER'S BOAT SHOW

One look at the new Evinrudes—and the latest boats now on display at your Evinrude dealer's—and you'll know you're in "dreamboat" land.

See them now. Choose the outfit you'd like to win. Get your Contest Entry Form and fill it in. You may win a family cruiser, powered with Evinrude's revolutionary 50 hp Starflite V-4—a smart runabout, powered with Evinrude's magnificent Lark—or one of 16 other Evinrude-powered boating outfits.

Whether you win or not, a sightseeing visit to your Evinrude dealer's will be reward enough. Take the family. They'll share the fun—and they can help you win!

A Division of Outboard Marine Corporation
In Canada: Mfd. by Evinrude Motors, Peterborough

FIRST PRIZE—Family Cruiser Outfit.
Evinrude 50 hp Starflite V-4 motor plus $3,000 in credit at your dealer for the dreamboat of your choice and accessories up to that amount.

SECOND PRIZE—Family Runabout Outfit.
Evinrude 35 hp Lark motor plus $1,200 in credit at your dealer for the family runabout of your choice and accessories up to that amount.

NEXT 16 PRIZES—4 each Week.
Evinrude 7½ hp Fleetwin motor plus $400 in credit at your dealer for the boat of your choice and accessories up to that amount.

GO TO YOUR EVINRUDE DEALER TODAY!
Here's all you do to enter!

1. Go to your Evinrude dealer (look for his name under "Outboard Motors" in the yellow pages).
2. Pick up official rules and entry blank.
3. Look at the boating outfits he has on display. Pick the one you'd like to win, and . . .
4. Say in 50 words or less why you'd like to win it.
5. Mail official entry blank to "Evinrude Contest."

EVINRUDE

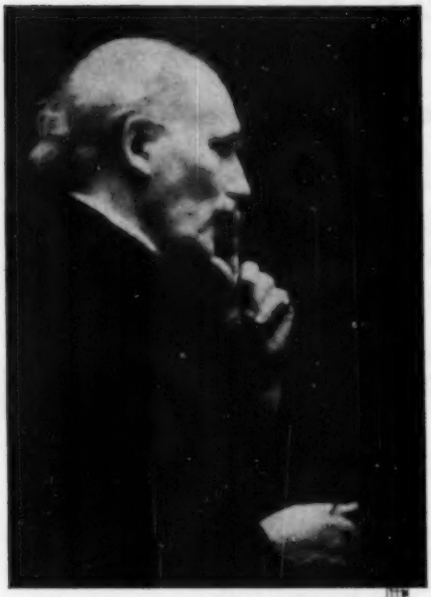
quiet outboard motors

RCA VICTOR and Book-of-the-Month Club

ANNOUNCE THE FORMATION OF

The RCA Victor Society of Great Music

...its common-sense purpose is to help serious lovers of music build up a fine record library *systematically* instead of haphazardly. By doing so, they can save ALMOST ONE THIRD of what they would pay otherwise for the same RCA VICTOR Red Seal Records.



AS THE HEART AND CORE OF A LIFETIME RECORD LIBRARY

BEGINNING MEMBERS WHO AGREE TO BUY SIX RCA VICTOR RED SEAL RECORDS FROM THE SOCIETY DURING THE NEXT YEAR WILL RECEIVE

The Nine Beethoven Symphonies

Arturo Toscanini

CONDUCTING THE NBC SYMPHONY ORCHESTRA

IN AN ALBUM OF SEVEN 12-INCH LONG-PLAYING RECORDS FOR

$3.98

—plus a small charge for mailing

Nationally advertised price $34.98

MOST MUSIC-LOVERS, in the back of their minds, certainly intend to build up for themselves a representative record library of the World's Great Music. Unfortunately, almost always they are haphazard in carrying out this aspiration. The new Society is designed to meet this common situation, sensibly, by making collection more systematic than it now is in most cases.

✱ Because of *more systematic* collection, operating costs can be greatly reduced, thus permitting extraordinary economies for the record collector. The remarkable Introductory Offer at the left is a dramatic demonstration. It represents a 45% saving the first year.

✱ Thereafter, continuing members can build their record library at almost a **ONE-THIRD SAVING.** For every two records purchased (from a group of at least fifty made available annually by the Society) *members will receive a third* RCA VICTOR *Red Seal Record free.*

✱ A cardinal feature of the plan is **GUIDANCE.** The Society has a Selection Panel whose sole business it is to determine "must-have" works for members. Members of the panel are as follows:

DEEMS TAYLOR, composer and commentator, Chairman.
SAMUEL CHOTZINOFF, General Music Director, NBC
JACQUES BARZUN, author and music critic
JOHN M. CONLY, editor of *High Fidelity*
AARON COPLAND, composer
ALFRED FRANKENSTEIN, music critic of *San Francisco Chronicle*
DOUGLAS MOORE, composer and Professor of Music, Columbia University
WILLIAM SCHUMAN, composer and president of Juilliard School of Music
CARLETON SPRAGUE SMITH, chief of Music Division, N. Y. Public Library
G. WALLACE WOODWORTH, Professor of Music, Harvard University

HOW THE SOCIETY OPERATES

EACH month, three or more RCA VICTOR Red Seal Records will be announced to members. One will always be singled out as the *record-of-the-month*, and unless the Society is otherwise instructed (on a simple form always provided), this record will be sent to the member. If the member does not want the work he may specify an alternate, or instruct the Society to send him nothing. For every record purchased, members will pay only $4.98, the nationally advertised price of RCA VICTOR Red Seal Records (plus a small charge for postage and handling).

RCA VICTOR Society of Great Music, c/o Book-of-the-Month Club, Inc., 345 Hudson St., New York 14, N. Y.

Please register me as a member and send me the seven-record *Toscanini-Beethoven Album* under the conditions stated at the left billing me $3.98, plus postage. If I continue, after buying six records, for every two records I purchase from the Society, I will receive a third RCA VICTOR Record, free. To maintain membership after the first year, I need buy only four records from the Society in any 12-month period.

MR. MRS. MISS } _____
(Please print plainly)

ADDRESS _____

CITY _____ ZONE _____ STATE _____

NOTE: If you wish to enroll through an authorized RCA VICTOR dealer, please fill in here:

DEALER'S NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____ V20-3

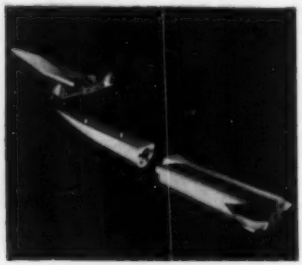
Founded in 1872 Vol. 172: No. 3 *Mechanics and Handicraft* REG. U.S. PAT. OFF.

Popular Science Monthly

March, 1958

Cover photograph by R. D. Borst

Competition for VW? GM's new little import is hungering for a piece of the small-car dollar. What's it like? How does it handle? PS gives you the facts



Here's how rocketeers may "shoot the moon"—in a winged third stage that doubles as satellite and ferry

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Big Plans for refurbishing the old homestead? Don't touch paintbrush to wood until you've got all the facts and figures to insure a top-notch job of house preparation. (Next month's bonus booklet will give you pointers on the actual painting.)

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PS Readers

TALK BACK

Peace, It's Wonderful

YOU'D think TV wasn't invented yet, evenings are that quiet again. For us grownups, I mean. The three kids— using your wonderful wireless earphones—still

get cheerful earfuls of police sirens and gunplay while they watch TV. Thanks for the article and for making the sets available.

M. E. CORNELIUS, St. Louis.

The reference is to "Wireless TV Phones Let You Listen or Not"—PS, Oct. '57: Readers can still get price lists and order forms for parts, kits or assembled sets from: Magazine Services, Inc., Dept. H-358, 104 E. 26th St., New York 10, N.Y.

Ferry Brings Back Memories

THE picture of the Burgh Island Ferry in England [Nov., p. 142] reminded me of the war years when my mother and I lived on Bigbury-on-Sea because of the raids on Plymouth. The island is almost half a mile out and there is a wide, sandy beach between it and shore at low tide. The prewar edition of the long-legged ferry was not unlike the present one. I remember seeing the rusted wreck. After the war, a DUCK was used. Now this has been replaced by the modern machine—an astounding piece of work.

I. S. BURR, Toronto.

New Figures for Rambler

IN YOUR January issue you goofed on the Rambler Deluxe [page 116]. The price, facts and figures you gave are for the Rambler Rebel V-8 Super. The price for the Deluxe is $2,047, weight 2,947, and it's a six with 6.40x15 tires.

E. C. GARDNER, Warsaw, N. Y.

A Plug for the Saber Saw

AUTHOR R. J. De Cristoforo in December did a good job comparing the bandsaw and the jigsaw. But he should have included the saber saw. It costs about half that of a jigsaw plus motor, about a third that of a bandsaw plus motor. Yet it does 90 percent of the jobs either will do and plenty more that neither will do.

My own bandsaw cost about $200, my jigsaw $150—my saber saw only $35. Incidentally, most craftsmen don't know at first what tools they need. I was no different from the rest. I had to learn.

In my opinion, a power shop should start with a good 3/8" medium-speed electric hand drill, an 8" or 10" table saw and a portable saber saw. When anyone asks me which tool to buy first—jigsaw or bandsaw—I say neither, buy a portable saber saw.

BOB LANKFORD, Fairdale, Ky.

See page 168 of this issue.

Horn Blast Would Deter Car Thief

I HAVE just read "The Shocking Facts on Car Theft." I'd like to suggest the following hook-up to discourage thieves:

When the switch is in "park" position, any attempt to jump the ignition lock will cause the horn to blow.

L. A. LENCINE, Queens Village, N. Y.

. . . Expecting Detroit to put satisfactory locks on cars is wishful thinking. Prewar Fords had good coincidental steering locks, but not now. Why should De-

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troit make cars robberyproof when the more cars there are stolen, the more new cars victims will have to buy?

As for the new crop of land-barges, at this rate cars won't be needing any paint. They'll be solid chrome.

EDWIN W. HUSER, Teaneck, N. J.

More Language Difficulties

IN THE January PS you show a Soviet typewriter with some typewritten material in it [p. 132]. Who translated for you the Russian sentence which you say is "our familiar 'Now is the time' quotation"? I bet you he is a Communist. This is not my, or any other American's, familiar quotation. The real translation is "Now is the time for all *brave* people to *join* the party." Since this was written in Russia, it can only mean one Party.

ROMAN HALUSHKA, Chicago.

Author Harry Walton brought the typewriter back to the U. S. The quotation, long used by practicing typists, was tapped out in the PS photographic studio, with Walton supplying the amateur translation from an English-Russian pocket dictionary.

He Says PS Misfired

IN YOUR December issue, you give the firing order of the Ford engine as 1-5-4-8-6-3-7-2. The firing order on my Ford engine is 1-5-4-2-6-3-7-8. How do you account for this?

V. J. BLACKMER, Milwaukee, Wis.

We failed to specify that the firing order shown was for the 292-cubic-inch engine. The firing order on your Ford applies to Ford Motor Co. engines with 332 and 352 cubages.

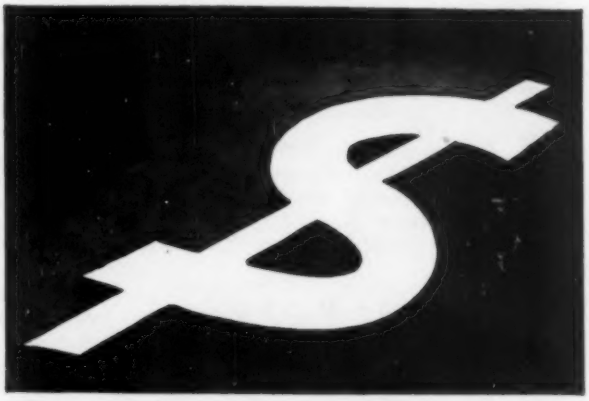
More Tips on Electric Shavers

YOUR article "How to Buy an Electric Shaver" [Dec.] failed to mention one important point.

Anyone buying a shaver should find out how long the head will wear—and if it's guaranteed for that time. In three months, the head went on a well-known shaver I purchased. There was no guarantee and the dealer asked $2 for a new

A BETTER JOB

MORE MONEY



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head. I put the shaver away and went back to my old one—a different brand and years old—which doesn't require a new head every few months.

HARRY TREIBLE, E. Stroudsberg, Pa.

. . . You seem to be a little overenthusiastic about electric shavers. I'd like to add a few additional tips for buyers:

Check for noise.

Check for motor coolness. The case

and head can get uncomfortably warm on some makes after a few minutes' use.

And here's an important fact that you omitted: No electric shaver will give a clean, comfortable shave on hot, humid days unless you use preshave lotion. When this is necessary, you might as well shave with a safety razor and get a very clean shave.

KEN GREENBERG, Chicago.

Shorter Short Cuts?

THE December Bonus Booklet, "Math Short Cuts for the Home Owner," gives an approximation for finding the capacity of a cylindrical tank. You can eliminate most of the approximation and the use of fractional feet, yet get a more accurate answer with this formula:

Using inches for diameter (D) and height (H): $D^2 \times H \times .0034 = \text{gal. cap.}$

ROSCOE LEEDY, Toledo, Ore.

. . . That three-step method of converting temperatures makes extra work. You can convert centigrade to Fahrenheit by multiplying by 1.8 and then adding 32. To convert Fahrenheit to centigrade, subtract 32 and divide by 1.8.

KIM BORISKIN, Brooklyn.

. . . Converting centigrade and Fahrenheit scales may be simplified to one equation for changing either way. By substituting the known value for either reading in the equation $9C = 5F - 160$, and solving the equation, the wanted value can be easily found.

BEN RANDALL, Naugatuck, Conn.

Man with a tough hair problem

Bill Flick of New Orleans captains a 45-foot cruiser for fishing parties. His hair takes a beating from sun, wind and spray.

He licks it with Vitalis

When he's having dinner out with friends, Bill's hair looks great because he uses Vitalis with V-7.

New greaseless way to keep your hair neat all day...and prevent dryness

Whether your hair takes a beating from the great outdoors or morning showers, you, too, will like the way Vitalis keeps it in condition... prevents dryness. And you never have a greasy look because Vitalis grooms with greaseless V-7. Use Vitalis every day.

New VITALIS® Hair Tonic with V-7®

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Radio-Television is America's fast growing industry. That's why it has special appeal to ambitious men not satisfied with their job and earnings. 4,000 Radio and TV stations on the air. 150 million home radios, 40 million TV sets. Plan now to get into Radio-TV. NRI can supply training quickly. Keep your job while learning. Soon after enrolling many students start to earn $10, $15 a week extra in spare time fixing sets for neighbors, pay for their course this way. Multi-tester you build helps make spare time earning.

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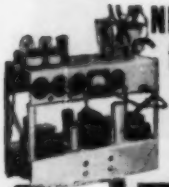
Electric Appliance Repair offers you good pay, SECURITY. Every wired home averages 8 electrical appliances. Up to 10 million more sold every year. Owners pay well to keep them in repair. Train now to earn more in a good job or step up your income with a business of your own. As an Appliance Service Technician your opportunities are broad—your services wanted, highly regarded in your community.



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ON THE HIGHWAY . . . *some spark plugs, designed for low speeds, misfire causing power loss and invite destructive pre-ignition when driven at high speeds. Why gamble when . . .*

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"Fire Up" your engine* at all speeds!

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Power Tip protrudes farther into the combustion chamber for better ignition. Fuel burns more evenly and completely to give top performance and economy at *all speeds.*

At low speeds, the projecting Power Tip is in the thick of combustion where it gets hot quicker and stays hot to burn fouling deposits away *clean.* At higher speeds, the projecting tip is in the path of the incoming air-fuel mixture where it stays cool to *check* power-robbing pre-ignition.

Ask your garage or service station to install Auto-Lite . . . the *only* spark plugs with Power Tip . . . and start enjoying top performance and economy from your car at *all speeds.*

*Power Tip, with or without Resistor, is ignition-engineered for overhead-valve V-8 engines and for most overhead-valve 6-cylinder engines in all these cars—Buick, Cadillac, Chevrolet, Chrysler, De Soto, Dodge, Edsel, Ford, Hudson, Imperial, Lincoln, Mercury, Oldsmobile, Nash, Packard, Plymouth, Pontiac, Rambler, Studebaker.

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The month in science

Science, schools and world power. The No. 1 casualty of the Cold War is complacency about the U.S. school system. Sputnik was the crusher.

Our lag in the race to space is blamed on an inadequate supply of scientists and engineers. *This* is blamed on the schools. Are they really at fault? If so, what should be done?

Here are some facts to remember when table-pounders shout at you. (The art of lying with statistics is being pushed to new heights in the current school debate. The figures below come from the U.S. Office of Education—they are trustworthy.)

- Nine out of 10 youngsters attend high schools that teach advanced math, physics, chemistry.
- But only 32 percent of those in the 11th grade, where chemistry is usually given, take it. The figure is much better—70 percent—if you look only at brighter students, those in the upper half of the class.
- In the 12th grade, only 23 percent take physics. For bright students, it's 50 percent.

On top of that, present science-math courses are outdated. (Evidence: vigorous criticism from university scientists, who should know.)

Is a complete reorganization of U.S. education overdue? Yes, say pleaders for a return to the good old days (most eloquent pleader: Rear Admiral Hyman G. [Atom-Sub] Rickover, who wants to go way, *way* back to the European system—see p. 107). Their plan:

- Concentrate on basic, tough subjects—math, science, composition, history; drop frills such as driver-training, dancing, diction, "life-adjustment" psychology.
- Give earnest, talented youngsters a complete and rigorous 12 years. Cut shorter the schooling of those who can't or won't learn.

This scheme riles most educators. They fear it would divide U.S. youngsters into two rigid classes: an intellectual elite marked for future glory and an undereducated proletariat barred from advancement. They point out that spotting talent early is still difficult. So a commission of leading schoolmen calls for upgrading across the board:

- Vast expansion and improvement of school plants and teaching staffs.
- Better guidance and testing to channel more talented students into tougher courses in all fields, not just science.
- Drastic revision of math-science courses. A new physics course is practically completed (you'd barely recognize it as the subject you once studied). In mathematics, statistics will replace solid geometry as a 12th-grade subject. Chemistry will get an overhauling, too.
- Continuance of the amazing diversity of American education, to train the great variety of experts we need, and to give everyone

clearer insight into our serious social and economic problems (foreign aid, segregation, farm surpluses).

This would cost a wad of money. Latest estimate: Double the $16 billion we now spend on schools every year.

Big question about either scheme for improving U.S. education: Will it impel kids to learn things that must be learned? Today, too few youngsters take tough courses in high school. A third of the very brightest (IQ of 155 or more) never go to college, points out Dael Wolfle in *America's Resources of Specialized Talent.*

The main reason: Their parents don't make them feel they have to.

This attitude seems to depend most on family background (religion, father's occupation), not on family economic status. Yet another hard fact of U.S. economics may make a real difference. This is the piddling reward for intellectual achievement. Astronomers average $6,000 a year, teachers less than $5,000.

The situation does seem to be improving. It will have to change faster if we are to come in first in the race for the world.

Parts from powder. A new process for pressing iron powder into tough solid parts for machines will cut the cost of the gears, cams, levers and ratchets that go into cars and appliances.

Powdered iron has been around for a long time. Heat and pressure solidify the loose powder, but the product was porous (good for oil-impregnated bearings, a big use) and not very strong.

The new method, developed by P. R. Mallory & Co., uses a different formulation to get:

- Very dense parts,
- Strengths approaching that of wrought steel,
- A one-step manufacturing process (before: as many as five steps).

The result: A wrought part that cost $1 can now be pressed from powder for 25 cents.

Still another development: Metal powder converted into sheet and strip (for atomic fuel elements, missile parts) in a big new mill devised by Stanat Manufacturing.

Skirts for males? Swedish scientists report that pants are dangerous—a hazard to future generations that could be "100 to 1,000 times greater than that from [atomic] radiation."

The trouble with trousers: They keep male reproductive cells too warm by about 5½ degrees. Heat, like atomic radiation, speeds up the mutation of the genes that transmit heredity. And increased mutation rates increase the chances of defective children being born. Tight clothing alone might be responsible for almost half the present mutation rate.

The scientists' suggestion: All men should wear kilts.

Martin Mann

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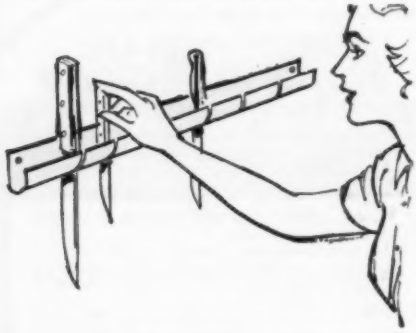
Keeping the Home Shipshape

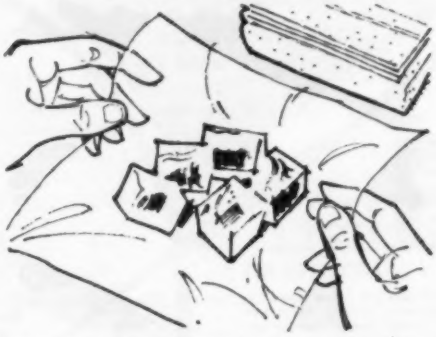
CLEANING OPENINGS OF A GAS-STOVE BURNER is easy if you use a bobby pin. Bend up the short leg of the pin at a right angle and use the other to ream out grease and dirt.

TO TIGHTEN LOOSE HANDLES on tools, put a soft putty of iron cement in the hole and insert the shank. If there is very little play, use stiff putty and coat the shank of the tool only.

FOR EASIER SHAMPOOS IN A SHOWER, put up a liquid-soap dispenser. If the wall is ceramic tile, drill holes with a masonry bit and mount the dispenser with expansion fasteners.



A QUICKIE KNIFE RACK for the kitchen wall can be made from metal stair nosing. Saw slots in the metal, spacing them a couple of inches apart, and mount it with roundhead screws.



IF THERE'S NO ICE BAG when you need one, try this: Package the ice cubes in a large sheet of clear-plastic wrap. Then when covered with a towel, they won't drip through so fast.

I'll Train You at Home for A BUSINESS OF YOUR OWN —OR A BETTER JOB

—R. C. Anderson, President of CTI

Only CTI sends you 25 training kits! At no extra cost, you get all parts and tools to assemble a heavy-duty, commercial-type, ¼ h.p. high-side (illustrated above). You work on 23 shop-type programs, do 10 trouble-shooting and repair projects—all in your own home!

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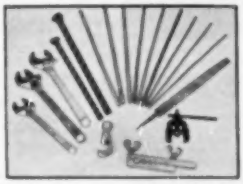
You've read about the amazing growth of the air conditioning and refrigeration industry. It's one of America's largest opportunity fields because over 150 million units are in use. Last year, 3 million refrigerators, 2 million air conditioners, and a million freezers were sold. All this adds up to a big demand for trained technicians who can install, repair and service. They make good money, work steady, enjoy security. Many open their own shops—become independent.

You can get ready for one of the top-pay jobs in just a few months. CTI will train you at home in spare time. You'll train with real kits, get practical experience as you go along. Be sure to mail coupon below for the full story on how you can succeed in this old, established, but growing industry!



Many Students Earn Extra Money as They Train

Many students, soon after they start training, do repairing in spare time. They work with local dealers evenings and week-ends. Others go "on their own." They earn extra cash, get added experience. Some land full-time jobs while students, and quite a number open shops. All this is possible because CTI training is so practical.

You Get Experience as You Train with Kits

You *practice* as you *train*, thanks to CTI Shop-Method Home Training. CTI trains you in months, not years—eliminates a long period of low-pay apprenticeship. At left are photos of but two of the 25 big kits you get—along with easy-to-understand, illustrated lessons.

YOUR BIG OPPORTUNITY TO OPEN A SHOP!

Students often build up a list of customers which includes not just homes, but office buildings, shops, food stores and industrial plants. They contract to do servicing on a fee basis, or simply answer calls. The Air Conditioning and Refrigeration field offers plenty of opportunity for independence. Own a shop—Be the boss! Mail coupon today!

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Prize Projects BY PS READERS

Plane Does Aerobatics. With a 65-hp. engine turning its controllable-pitch propeller, this lightplane hits 125 m.p.h., has a 55-m.p.h. stalling speed. Earl and Jerry Adkisson of Tuscola, Ill., designed and built it. Fuselage is metal: stressed skin aft of the cockpit, steel-tube frame up forward. The 24-foot wing is fabric-covered; landing gear came from a Cessna.

Radiator Covers. Built as one unit, the radiator covers made by K. W. Nittel of N. Attleboro, Mass., have handy storage shelves in the often-wasted space between two radiators. The entire unit can be pulled out, or the perforated sheet-metal front alone can be lifted off. A hole in each end piece makes it easy to reach inside to turn either control valve. Top and rear of the covers are lined with sheets of aluminum-faced building paper.

35-M.P.H. Midget Racer. The hinged hood and steering wheel of this quarter-midget car swing out of the way when Don Janke of Westbury, N. Y., his mother or dad (who made it) gets in. An aluminum body rides on a chassis welded from 1″ square tubing. A 2½-hp. gas engine with an 8:1 engine-to-axle ratio powers the car through a centrifugal clutch. Rack-and-pinion steering mechanism came from an orange squeezer, brakes from an old Crosley.

Have *you* recently completed a workshop project of which you are particularly proud? Send a good photograph of your work, along with the negative and a brief description, to the Mechanics and Handicraft Editor, POPULAR SCIENCE, 353 Fourth Ave., New York 10, N. Y. We will pay $15 for each item that is accepted for publication.

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—Michael Balitsky, Newark, N. J.

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—C. L. Vanerstrom, Mich.

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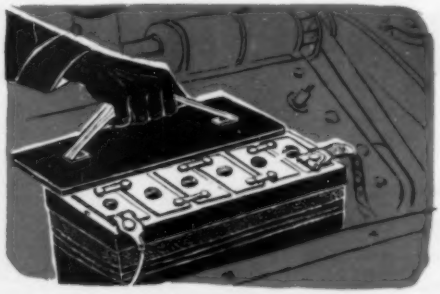
"I'd like to see them make..."

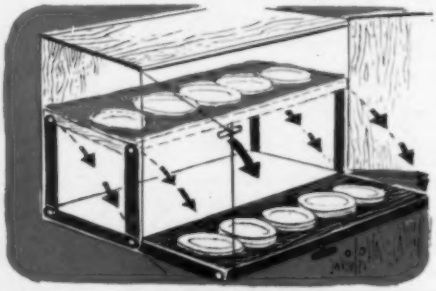
PLASTIC BUBBLES that could be hung on the house outside basement windows. These miniature hothouses would admit sun and utilize cellar heat, too.—*J. R. Wozny, Cleveland.*



A ONE-PIECE BATTERY CAP that would snap on or plug into a 12-volt, six-cell battery. You'd pull a strap-type handle and remove all caps at once. —*Ken Stofen, Racine, Wisc.*

SIDE-OPENING BARRACKS BAGS to eliminate dumping out the contents to find one item. A zipper running from top to bottom would make a GI's life easier.—*John P. Joyce, NYC.*

WINDOW-LIFTING JACKS. A flat blade slipped between the sill and sash would raise a paint-stuck or swollen window without marring it. —*Steve Krasik, Sherman Oaks, Calif.*



SWING-DOWN CABINET SHELVES. Mounted on parallel metal arms, they would pivot forward and down within easy reach for loading or unloading.—*Lenore Sherman, Miami, Fla.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE readers. What's *yours?* We will pay $5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

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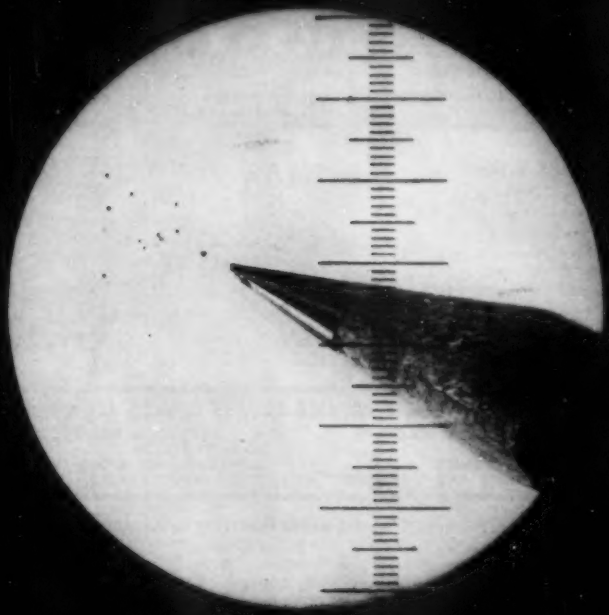

can shorten your engine life

Waste and abrasive particles *far too small to see* with the naked eye can have a deadly effect on engine performance. That's the problem that led to the development of the MoPar Micronic Oil Filter. It eliminates even these particles from the oil system, to the size of a *micron* (.000039 of an inch).

This means that the filter catches over ⅓ more dirt per square inch than ordinary filters. Chrysler Corporation Engineers perfected the method by means of a special filter element paper. These "Forward Look" engineers also developed—

- greatly increased filtering speed—because the filter surface area is over 8 times larger than conventional types—571 inches against 69.
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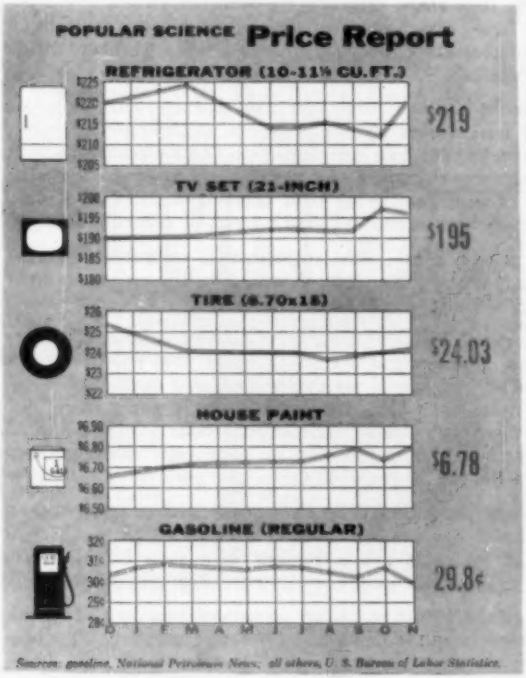
You ought to know...

Will prices drop? Don't look for it. Prices are notoriously sticky. Sure the U.S. economy stumbled. But businessmen try to sit tight. Shaving prices right away would only reduce overall profits still more, since the volume of sales would hardly increase enough to make up for the lowered margin on each unit.

Even so—now's a good time to shop. Most prices are steady but it's a buyer's market. You may run across a merchant who's loaded. *He* will have to move goods (to pay his bills). He'll deal.



Remember this, when you shop right now: The chance for a really good buy depends on *what* you buy. For instance:

▶ Houses. Construction, way off for months, is inching ahead. Recent steps toward easier credit will help you swing a new house, but will firm up asking prices.

▶ Building materials. If the construction rate climbs, so will the price of lumber (a good buy lately). Paint prices have been climbing steadily (see chart), show every sign of continuing to.

▶ Cars. There's been no mad rush to buy the '58s. Quite the opposite. If you're shopping for a new bus, haggle shamelessly. But hurry: March is getting late. A dealer may let you walk out, unsigned, knowing that sales bloom in the spring.

▶ Appliances. Depends where you live. In Chicago, refrigerators were $15 *above* the latest PS Price Report average; in Los Angeles, $9 *below*. In Detroit, TV sets ran $15 *above* average; in New York $15 *below*.

▶ Gas. This will be cheaper—sinking steadily since last summer, as the Price Report chart shows. Raw petroleum is brimming over. In two large cities, Los Angeles and Philadelphia, the gas price dropped sharply.

The long view, for most of the things you buy: fairly steady prices into summer. And then, if our "rolling readjustment" stops

You ought to know...

rolling, as most economists predict: *Climbing prices again.*

Your car is loaded with possible income-tax deductions. It's worth the time and effort to tabulate them, while you're sweating over Form 1040 before the April 15 deadline. They add up.

But the line is sometimes hard to follow between car costs you can and cannot claim. To help you sort them out, J. K. Lasser Tax Institute, New York City, has furnished this check list:

- Your bill of sale may show a retail-sales tax, from your city, state or both. Or a "use" tax if you bought outside your community, say in an adjoining state. If you got your car last year, either tax is fully deductible.
- Interest charge is another item you can deduct, assuming you bought car or accessories by installments, or borrowed money with the car as security. You can deduct up to six percent of the average balance owed during the year, but not more than the total carrying charge you paid. Your lending institution should be able to supply you with the year's total of interest charges.
- Fees for the license plate, title registration, operator's license, auto stamp tax are also allowable. Learn, too, if your community has a property tax on the car(s) you own.
- Gasoline taxes are charged by the Federal Government, all states and some cities. The federal tax on gas—like that for new tires, radios, heaters and so on—is an excise and *not* deductible. But state and city taxes *are*. They run from 3¢ to 7¢ per gallon. The Internal Revenue Service lets you compute your average annual total: It's the year's mileage divided by your car's gas consumption multiplied by the deductible taxes per gallon.
- Some travel costs are deductible. You *can't*, of course, deduct for commutation costs between home and place of work. But you *can* deduct for costs when driving from your full-time job to an extra job, or between two places of business.
- Civic and charitable work runs up expenses that are often allowed: Volunteer hospital work, civil-defense meetings, authorized drills of military-reserve units. In the case of drills, round-trip cost is allowed if the duty is outside your city or neighborhood of work, only one-way cost otherwise.
- Damages from any accident (minus any insurance collected) are deductible, except if caused by willful negligence.
- Theft is provided for. You're allowed the difference in the car's value immediately before the theft and after its return, less any insurance you get. So long as your figure doesn't exceed the cost of the car itself, the Government sometimes permits you to deduct the cost of repairing it. For a stolen car not returned, you're allowed its "fair value," minus any insurance you get.

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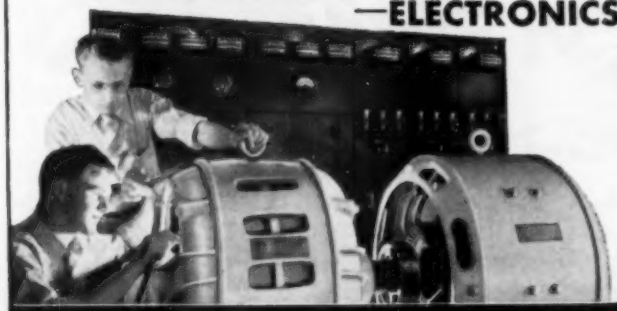

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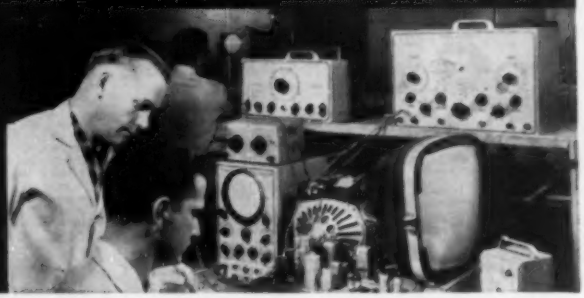

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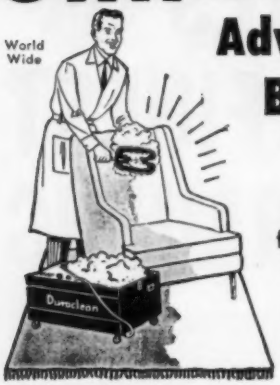

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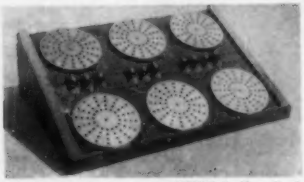

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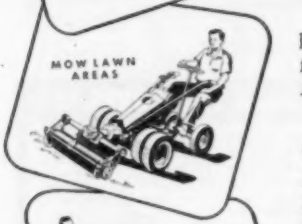

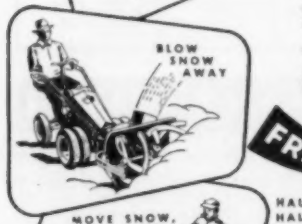

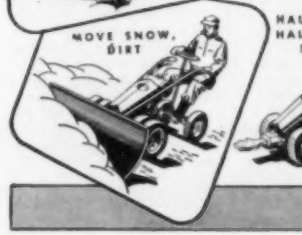

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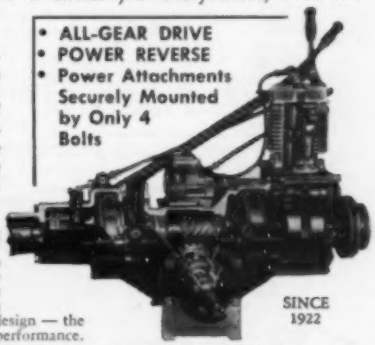

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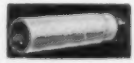

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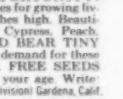

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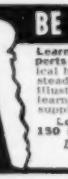

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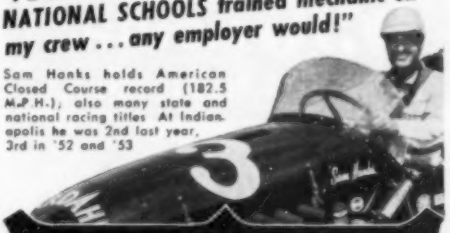

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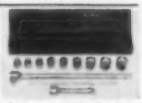

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650-16(6)	6.45	710-15	5.35	750-17	12.75	825-20	18.55
700-15	6.25	760-15	5.45	600-20	9.65	900-20	18.75
750-16(6)	7.45	800-15	5.75	650-20	10.75	1000-20	19.75
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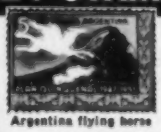
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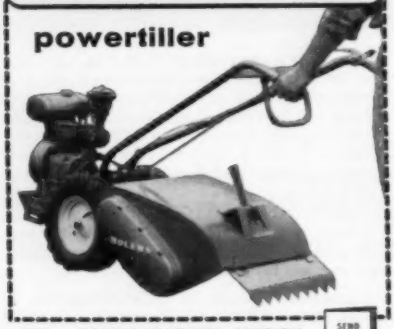

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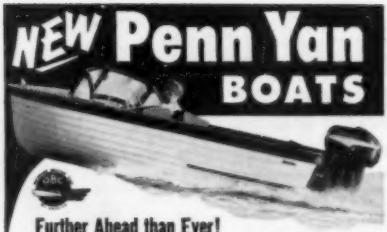

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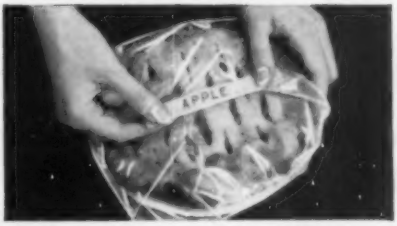

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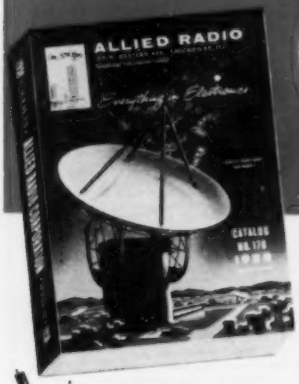

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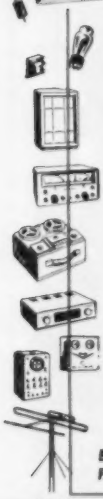

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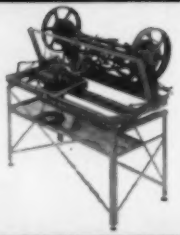

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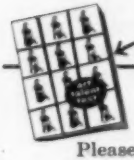

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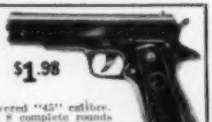

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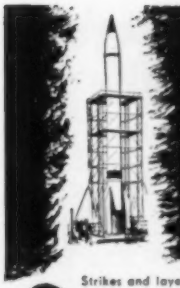

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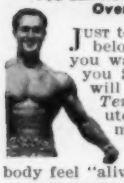

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650x16	(6) 7.25	710x15	5.45	750x17		16.45	825x20		21.50
700x16	6.35	760x15	5.95	750x15		10.95	900x20		19.95
750x16	(6) 8.45	800x15	6.35	30x5		11.25	1000x20		20.45
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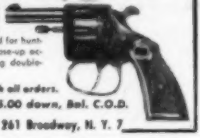

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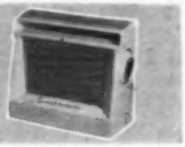

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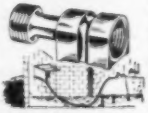

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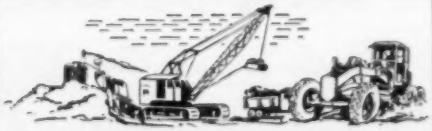

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(If ground is not frozen)

BLUE-GREEN

MONDO "GRASS"

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REQUIRES NO MOWING —GREATLY BEAUTIFIES LAWN

Buy the ONLY genuine Mondo "Grass" from us. Beware of imitations.

Blue-Green Mondo "Grass" is described by the U. S. Department of Agriculture as "Ophiopogon Japonicus (formerly called Mondo Japonicus), is native to Northern China and should withstand severe degree of freezing; evergreen, commonly called Mondo Grass."

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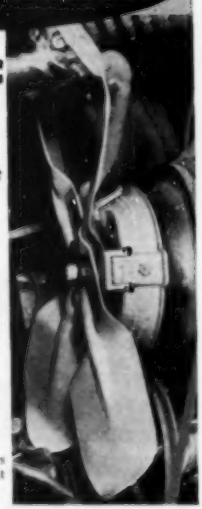

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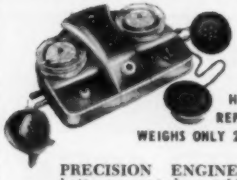

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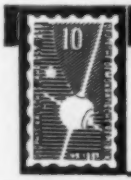

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Popular Science Monthly in cooperation with the Home Improvement Council

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PLUS 500 FREE Bernz-O-Matic Torch Kits given to the first 500—who enter! 500 famous TX-888 Bernz-O-Matic Torch Kits (retail price $8.88)—consisting of the famous Bernz-O-Matic Torch, Utility Burner Head, Flame Spreader and Soldering Tip. Qualify for a FREE Torch Kit by participating in the GIANT Home Improvement Council Contest.

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Act quickly—be among the FIRST 500 to return the entry blank completely filled out and you'll WIN A BERNZ-O-MATIC TORCH KIT. Winners will be judged by the earliest postmark. In case of a tie—duplicate prizes will be awarded.

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Popular Science-Home Improvement Council
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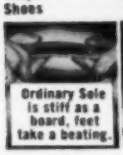

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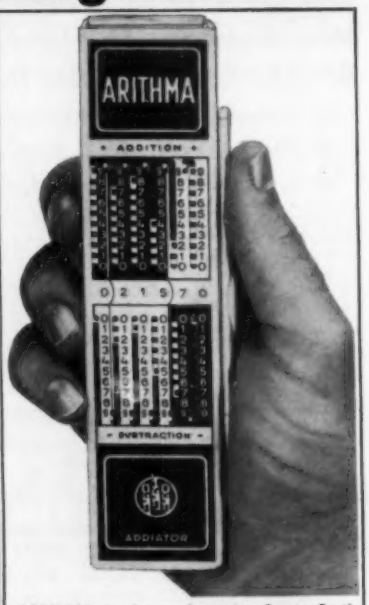

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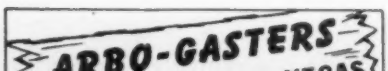

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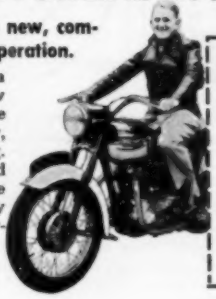

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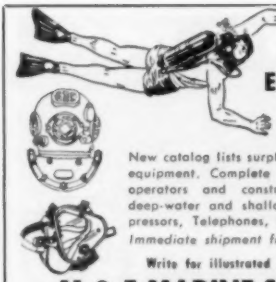

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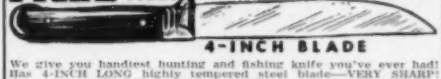

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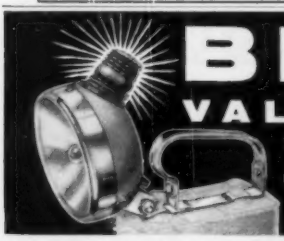

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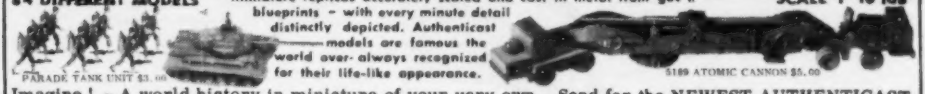

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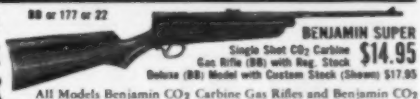

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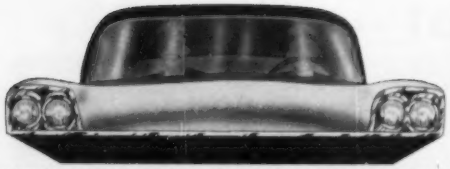

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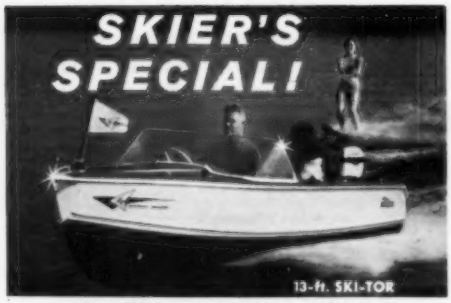

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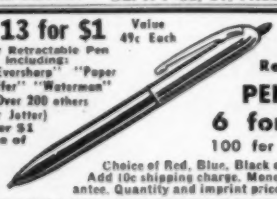

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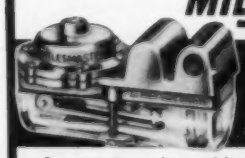

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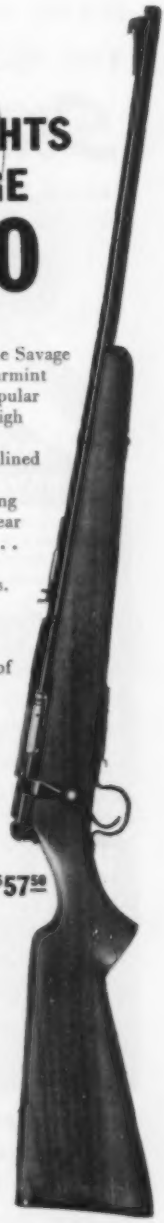

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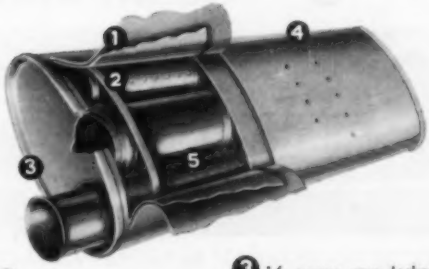

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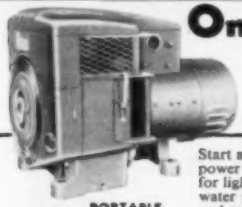

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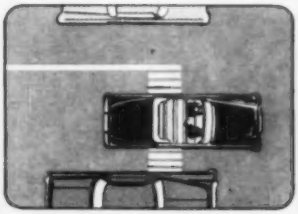
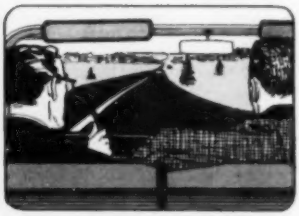
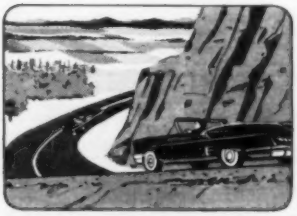
"Save gas right from the start. Depress accelerator halfway before starting. Let your engine idle at least 30 seconds before moving. Stay under 30 mph until engine warms up."



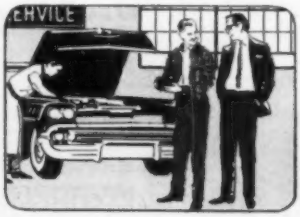
"Don't race away from stops. Accelerating hard in low gears wastes gas, and it's not worth the wear on your engine. Take it from me, you'll get there faster by taking it easy."



"A pro always drives with a steady foot. Uneven acceleration—slowing, then speeding up—burns far more fuel than cruising at a steady pace. And it's far safer, more relaxing."



"Keep well back of the car ahead. You can maintain steady, thrifty speeds, avoid sudden stops and gas-consuming starts. And you'll avoid situations that result in accidents."

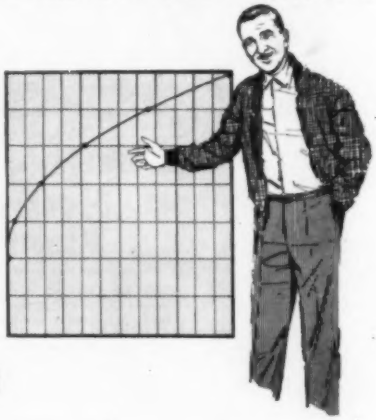


"Take a tip from a pro. Keep your car at peak efficiency. If you drive in traffic, it's a good idea to have your carburetor and other vital engine parts checked every 8,000 miles or so."

"Remember, your carburetor is the heart of your performance. Periodic checks and adjustments by a factory-trained mechanic can save you money in improved gas mileage."

Better gas mileage is usually in your hands. Check your own driving habits. Then, have a Rochester Carburetor specialist diagnose your engine for peak performance. He's factory-trained in the precision maintenance of your carburetor. And he'll help you get top efficiency . . . and extra miles from every gallon of gas. ***Rochester Products Division of General Motors, Rochester, New York.***

Mauri Rose top professional driver, points out how your gas consumption goes up sharply with every increase you make in driving speed.



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The Fantastic Problems of Ballistic-Missile Warfare

New advances have yielded rocket weapons of unprecedented power for attack—and now the defense is trying to catch up

By Frank Harvey

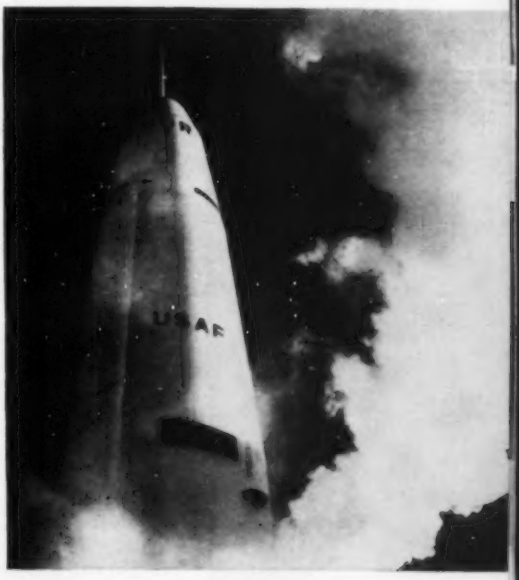
BEFORE year's end, America will be in business with its space-vaulting ballistic missiles. Two intermediate-range missiles—Thor and Jupiter—have already been ordered into production. These IRBMs, capable of carrying a thermonuclear warhead to a target at least 1,500 miles away, are to be based overseas. Also being rushed toward operational status are our first ICBM or intercontinental ballistic missile, the 5,000-mile Atlas; a second ICBM, the Titan; and a third IRBM, the Polaris.

A ballistic missile is an intelligent projectile. A rocket engine powers it during the first part of its flight. During those few minutes it receives all the thrust and guidance it gets. It is a remarkably complex weapon, demanding great technical feats in separate areas of propulsion, guidance, re-entry design, and warhead design. Here are some of the fantastic aspects of this weapon:

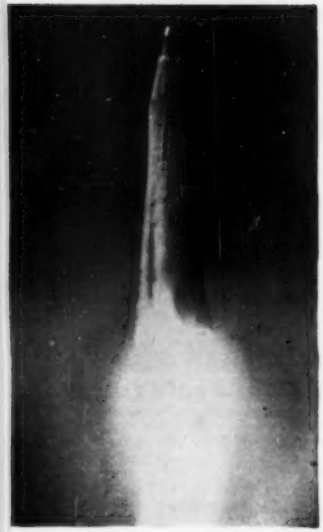
Propulsion, just to get the missile from the launching site to the target area, calls for rocket engines of unprecedented range. To go from the Channel-spanning V-2s of World War II, to missiles able to travel 1,500 to 5,000 miles, represents an extraordinary technological feat in itself.

You might expect that it would call for the use of three or four successive rocket stages. Surprisingly, a single stage suffices for the Air Force's Thor and Atlas, with the aid of "boosters" furnishing additional power at takeoff. And, while novel "high-energy" fuels figure prominently in forward-looking research, these Air Force missiles use a standard rocket-fuel combination—kerosene and liquid oxygen,

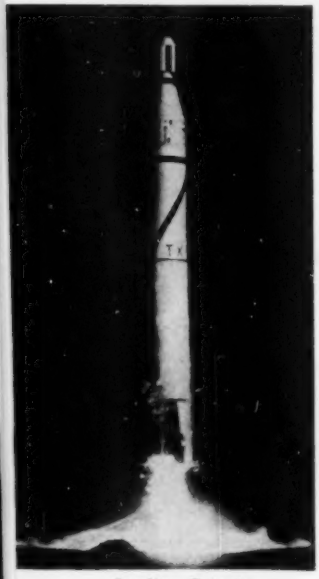
To arm outposts: IRBMs like this



Thor, vapor-wreathed from liquid-oxygen vent, could hit Russian targets from overseas base



Atlas, an 80-foot-tall intercontinental missile, soars aloft with a'd of twin boosters



Jupiter C test vehicle begins flight with successful new re-entry nose cone

familiarly called lox. So, it's reported, do the Russians' long-range missiles and their Sputnik-launching rockets.

Behind the phenomenal power and range of today's missiles, then, at least a major factor appears to have been a tremendous advance in rocket-engine design. What little can be learned of performance figures bears this out. For example, the rocket engine of the Army's Redstone missile—a 200-to-300-mile-range forerunner of the Jupiter—is a third shorter than that of the V-2; yet it belches 52 pounds of thrust per pound of weight, as against a 29-to-one ratio for the German engine.

Development of lighter-weight but strong missile structures undoubtedly has been another key advance. The range of ballistic missiles is known to be especially sensitive to the ratio of propellant weight to total weight.

Ballistic missiles make satellite-launching vehicles, too. Jupiter C has put the first U. S. satellite into orbit, Thor is to be adapted for moon-boosting, and plans are reported to use Atlas to put up a satellite as big as Sputnik II.

So far the big long-range missiles have employed liquid fuels. But some see promise in solid fuels, consisting of powerful chemicals embedded in a rubber matrix. The Navy's IRBM, the Polaris, is such a solid-fuel missile. And the Thiokol Chemical Corporation has set up a test stand for trials of a solid-fuel rocket 12 feet in diameter, which will develop 2,000,000 pounds of thrust—the most powerful engine known at this time.

Guidance sees to it that a missile, given the necessary range, hits the target that it's supposed to.

The guidance system directs the course of a missile arching into space, until the accelerating projectile has just the right direction and velocity to come down at the right place. At that critical instant, the "thrust-cutoff point," the system shuts off rocket power. The missile coasts the rest of the way, reaching an apogee, or maximum altitude, of 400 to 700 miles, and then falling upon its distant target at 18,000 m.p.h. An error of one m.p.h. in 18,000 can make it miss a target by 1½ miles.

The built-in system generally favored, called "inertial guidance," amounts to a gyropilot and position finder of almost incredibie precision. Preset for a chosen target and exercising automatic control over the missile's course, it dispenses with radio guidance or other external means of control, and is proof against interference by enemy "jamming."

At the country's biggest plant for making these gyro-filled "black boxes," erected near Milwaukee by the AC Spark Plug Division of General Motors, they're tooled to tolerances that make a gnat's eyelash seem like a large palm frond: 20 millionths of an inch, in some critical places. So reliable is the gyro that it could spin 14,000 r.p.m. for 14 years and not gain or lose one revolution.

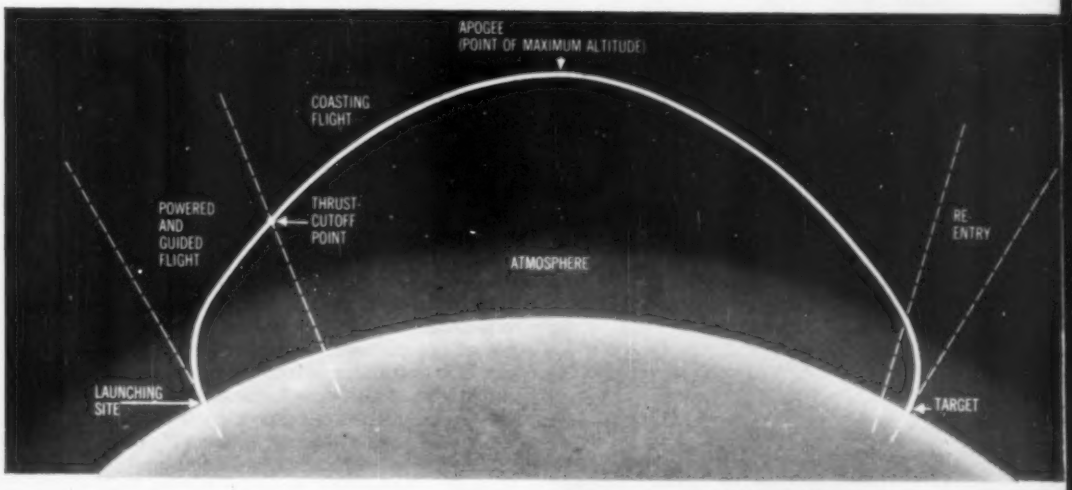
Re-entry becomes the big problem at the end of the missile's flight. Out in space, the coasting projectile comes apart like the one-hoss shay. It descends into the atmosphere as a heap of hardware flying in formation—pumps, tanks, tubing, electronic gear, and the nose cone carrying the hydrogen warhead. Pieces of trash hardware, like the tanks and tubes, all turn into junior-grade meteors. But the nose-cone package

must somehow survive the 14,000-degree-F. heat of air friction at re-entry, without blazing into molten rain.

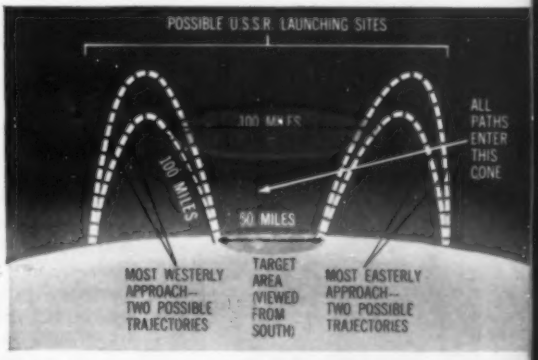
A Jupiter nose cone fished from the sea after a flight through space, and exhibited last November, showed that we've succeeded in finding the answer.

Those in the know aren't saying how this problem has been solved, but certain basic factors are known. The tip of the cone will be made blunt, as Jupiter's could be seen to be, to avoid "needle-point incandescence"; tests in hypersonic wind tunnels have shown that hatpin cones just can't take it. Possibly the nose cone might be made of a special heat-resisting metal, or, as suggested by the appearance of the Jupiter cone's unidentified material, a super-refractory ceramic. Either material probably would be polished to mirror smoothness to cut down burbling, which transfers heat much more rapidly than an onion-skin layer. There has been talk of "sweating" water or some other coolant through pores of the cone during re-entry. A still more Buck Rogerish approach might fasten a sort of "bug deflector" on a rod ahead of the missile—a button of diamondlike material, glowing like the sun while it punches a hole in the air for the body of the missile to sneak through.

A missile's course to hit a distant target



Long-range ballistic missile's trajectory takes it into space and back. From thrust-cutoff point, it coasts, follows elliptical path like earth satellite, re-enters the atmosphere near its target



Defense, though difficult, is aided by fact that missiles' approach is limited to this narrow angle

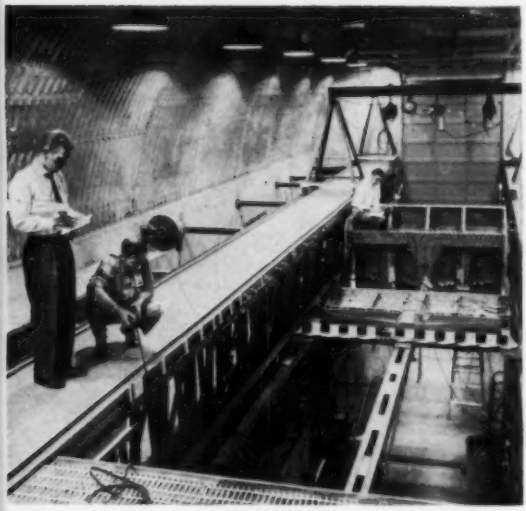
The warhead that goes inside the ballistic missile's nose cone once seemed the "impossible" problem. What held up American ICBM development so long was the seeming pointlessness of spending billions of dollars to send a little A-bomb across 5,000 miles of land and sea, maybe miss by a mile or so, and just get people mad over there.

Then came the breakthrough—small-size, high-yield hydro-

gen warheads—and that problem was disposed of. With the Big Bang, you could miss by quite a few miles, and still wipe out the intended target.

Just how nuclear mechanisms were engineered to withstand the brutal shock of rocket acceleration, only a trusted few may ever know. But a glimpse of the kind of test equipment likely to have been used was recently provided when the Sandia Corporation, maker of U. S. nuclear weapons, released photographs of a shock-cord catapult that subjects "nuclear-weapon components" to as many as 54 G's in acceleration tests at Albuquerque, N. M.

Catapult test for nuclear warhead



Secret atomic fittings take up to 54 G's in acceleration trial (cart above, right). Shock cords, pusher beam drive cart. Below: rubber cords beside cart's front

With these problems solved, the first IRBMs and ICBMs are a fact. When they're turned out in quantity and become operational—which won't be long, and may already be the case for 800-900-mile Russian IRBMs—the military consequences will be staggering.

At any moment, an attack moving at thousands of miles an hour could be launched upon a country hundreds to thousands of miles away. Former obstacles of oceans and terrain would vanish. The heartland of every country—ours included—would become vulnerable to what has been called "a weapon system that can kill a nation in half an hour."

Surprise could be complete, even if open-sky inspection were in force. For the hypersonic tempo of this novel kind of warfare will require missile bases to keep their "birds" always poised ready to fly. To an aerial observer, a launching site's activities at "H-hour minus 2" would look just the same as on any other day.

Is there any defense against ballistic missiles?

Today, no counterweapon exists. An anti-ICBM missile is still years away at best. The problems of developing one look enormous, though by no means hopeless.

"The very nature of the ballistic trajectory, a path that is unvariable and quickly and easily computed, may be its undoing," suggests the Air Force's Col. Alexander Sheridan. Determine any two points on an ICBM's course, and you can predict the rest of its path to the very point of impact—the information you need, to try to intercept it with an anti-missile missile.

Moreover, since ICBMs descend steeply, all possible paths to a particular target have to converge within a slender cone over the target area. That means a relatively narrow "approach corridor" to defend.

Efforts to produce an "ICBM killer" now are reportedly concentrated on the Army's projected Nike-Zeus anti-missile missile. Its hush-hush design, called past the drawing-board stage, can only be guessed at.

An "auntie" would probably carry a powerful nuclear warhead. If it met an ICBM outside the earth's atmosphere, the atomic explosion would be the strangest ever triggered. In empty space there would be virtually no blast or sound—

only a flood of searing heat and radioactivity, the more intense and far-reaching for lack of air to absorb it. The hope would be that the heat would destroy the nose cone, or that the radioactivity would turn the warhead into a dud. To a nose cone barely able at best to survive the heat of re-entry, a well-timed nuclear heat wave would be likely to be fatal.

A countermissile alternatively might throw out billions of sandlike particles—clouds of them, occupying hundreds of cubic miles—in an ICBM's path. At an impact velocity of 18,000 m.p.h. the grains would have a destructive effect far out of proportion to their size. Even if they failed to riddle and wreck the nose cone, they might nevertheless pit and abrade its smooth surface enough to cause its overheating and destruction in re-entry.

Of course a better defense, and the only possible kind in lieu of a specific counterweapon, is the preventive one. You'll live in peace as long as you're prepared for massive retaliation with ballistic missiles of your own—and a would-be aggressor knows you have that ability.

But offense has usually had the edge on defense—and now that offense packs a multi-megaton punch, the odds have soared. Would retaliation be possible, if an aggressor hit your missile sites and bomber bases all at once, with a shower of hydrogen warheads?

At any base of yours, it would be a close thing whether you get your missiles off before you're dead. While a missile stands on a launching pad, lox boils away rapidly, and a tankful must be "topped" with fresh lox for flight. If you're on "red-alert" you could ready a liquid-fuel missile for firing in about 15 minutes. Your first warning may give you that little time, or less.

Solid-fuel missiles, the real "pushbutton" weapons, could be fired instantly. But there's another catch.

Long-range warning radar, with its necessarily high power, brings in a bewildering confusion of blips—meteor showers, northern lights, space clouds, as well as a possible ICBM. How long will it take to confirm beyond doubt that a radar image is actually a hostile ICBM? Imagine countries plunged into war because a radar observer mistook a meteor for an ICBM, and you see why the fateful order to press the red button can come only from the highest level—even though the clock may be ticking toward eternity while it's on the way.

One answer to such disquieting problems is simply to have so many scattered retaliatory bases that no attacker could hope to hit them all at once.

Further, as the Navy is quick to point out, long-range ballistic missiles can hit only fixed targets—of known latitude and longitude. They can't hit mobile targets like naval vessels. So, no matter how successfully an attacker liquidated land bases, he couldn't expect to escape retaliation from missile-firing ships.

At a recent missile conference in Washington, a panel of experts found themselves in total agreement on only a few points, but among them were these:

"Our best defense against enemy ICBMs is a whopping big stockpile of our own ICBMs . . . many widely dispersed launching sites . . . and trained crews on hand to fire within minutes if necessary." END

A ride for a "moon" on an IRBM

Long-range missiles can launch satellites too. Above, Jupiter C is fitted with a "moon" of the kind it has successfully launched. A much bigger one may be put up by Atlas ICBM

U. S. missile designer forecasts:

What's Coming in Rockets

Krafft A. Ehricke is a rocket scientist with Convair, the company building the Atlas ICBM, and chairman of the Space Flight Committee of the American Rocket Society.

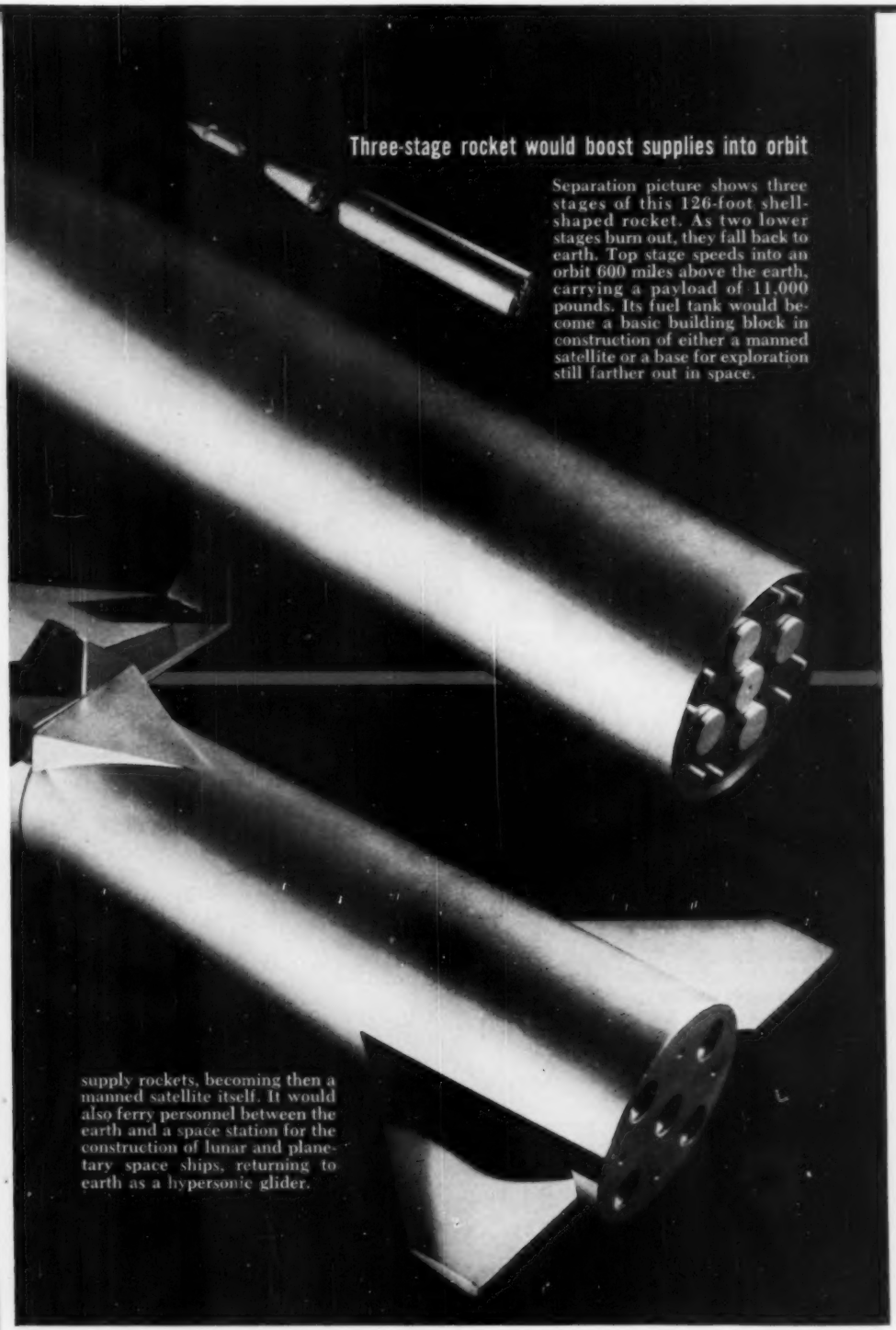
By Herbert O. Johansen

A JOINT military-civilian program for U. S. exploration of interplanetary space has been proposed to the President by a group of rocket scientists. Krafft A. Ehricke, who helped design both the German V-2 and our Atlas intercontinental ballistic missile, is their spokesman.

Under this proposal our first foothold in space would be gained by a modified intercontinental-ballistic-missile rocket. Its nuclear warhead would be replaced by a cabin or a cargo nose to carry materials and men far above the atmosphere. There spacemen would (1) build a manned scientific, earth-orbiting satellite station; (2) take the first, cautious, probing steps of space flight—moon reconnaissance and

Winged glider forms the third stage of rocket to boost man into space orbit

Three-stage arrangement of the 130-foot rocket is shown directly above. Top stage, riding piggyback on the second stage, would carry a pilot and four passengers into the satellite orbit in the same manner as the automatic



Three-stage rocket would boost supplies into orbit

Separation picture shows three stages of this 126-foot shell-shaped rocket. As two lower stages burn out, they fall back to earth. Top stage speeds into an orbit 600 miles above the earth, carrying a payload of 11,000 pounds. Its fuel tank would become a basic building block in construction of either a manned satellite or a base for exploration still farther out in space.

supply rockets, becoming then a manned satellite itself. It would also ferry personnel between the earth and a space station for the construction of lunar and planetary space ships, returning to earth as a hypersonic glider.

then interplanetary exploration voyages.

Only by a joint venture of the military missile men and civilian scientists can we achieve space flight in our time, according to Ehricke.

"A rocket is a 'weapon,'" he says, "whether you launch it to destroy an enemy target on earth or for the peaceful conquest of space to gain scientific knowledge, and prestige among the world of nations. We cannot afford the luxury of duplication—of non-complementary military and civilian programs."

ICBM rockets, to achieve their military missions, must be able to boost their nuclear warheads, weighing hundreds of pounds, to speeds of 15,000 miles an hour or more, and to altitudes hundreds of miles above the earth. That puts us on the threshold of 18,000-mile-an-hour satellite flight, and brings us close to the 25,000-mile-an-hour speed needed for lunar and interplanetary flight.

Rockets are the hardware of space flight. Their military significance cannot be denied. But out of the atom bomb came the "atoms-for-peace" program. The report submitted to the President by Ehricke's Space Flight Committee of the American Rocket Society recommends the establishment of a national space-flight program under the supervision of an astronautics agency similar to the Atomic Energy Commission and the National Advisory Committee for Aeronautics.

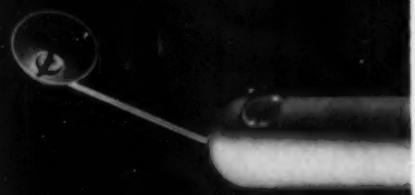
The report also sets forth a six-step program that would make space flight a reality within the next 20 years "without any major technological breakthrough." The goals are these:

1. An earth satellite with a payload of several thousand pounds within *five years.*
2. A payload of several hundred pounds placed on the moon within *five to 10 years.*
3. A similar payload sent out to the nearest planets—Mars and Venus—within *five to 10 years.*
4. A manned earth satellite within *10 years.*
5. Manned flight around the moon within *15 years.*
6. Manned, two-way moon flights, including landings within *20 years.*

Payloads of the *unmanned* vehicles would contain scientific instruments, radio transmitters, TV cameras, animals.

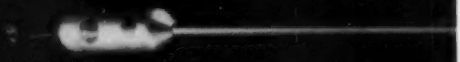
Krafft Ehricke's family of space ve-

Dumbbell-shaped observational satellite would be assembled by man in the orbit



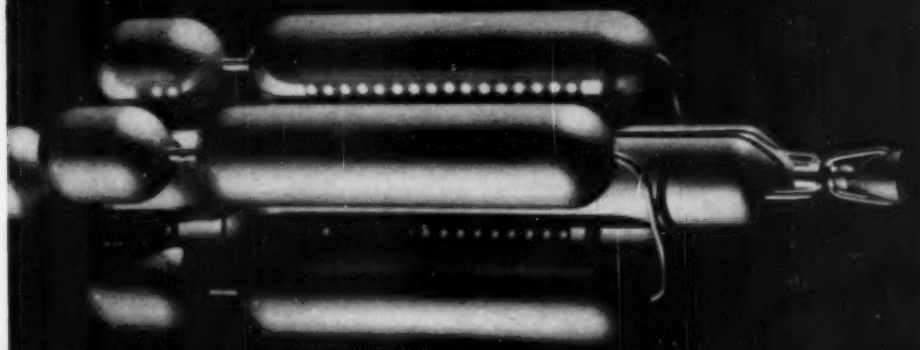
Around-the-moon-flight rocket ship would take off from satellite orbit

Power for manned interplanetary flight



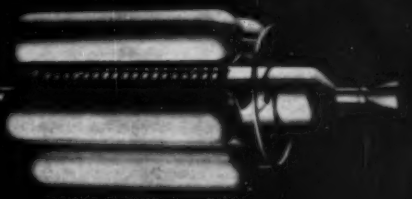
The engine of this slim space vehicle is a nuclear pile that heats a working fluid, liquid hydrogen. The hot, expanding gas, exhausted through a rear nozzle, furnishes thrust as in a conventional rocket. The hydrogen tanks surrounding the pile shadow-shield the crew—

Fuel and oxidizer tanks of the automatic supply rockets would be the basic building blocks for putting together this 400-foot-long space station—and test bed to condition men to space. Crew of four would live and work in quarters at either end of the vehicle, which would rotate slowly to create artificial gravity by centrifugal force. Center compartment would contain power supply, radar and television for scanning the earth as the station speeds in its 600-mile-high orbit.

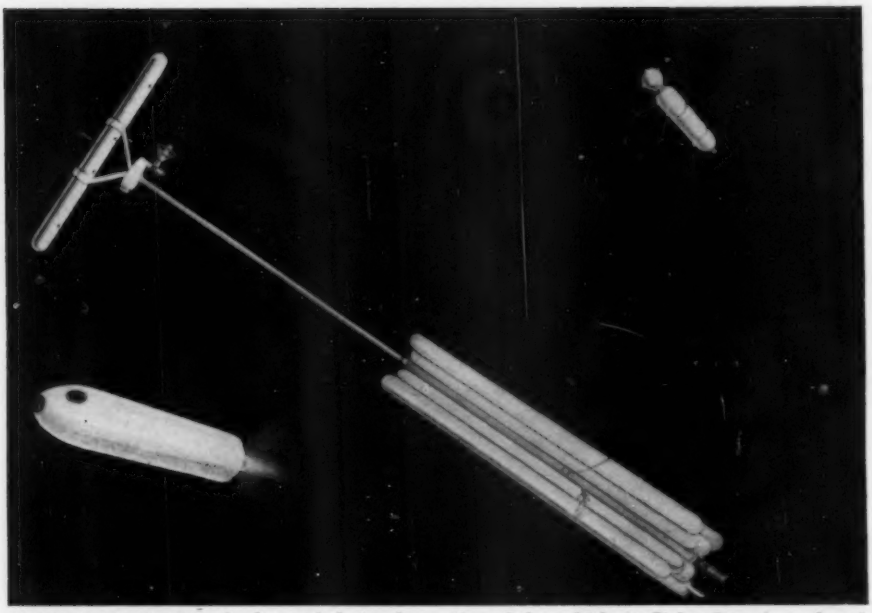


This lunar-reconnaissance vehicle would take man for his first view of the other side of the moon. Assembled in the orbit like the space station, it has four fuel and oxidizer tanks for flight to the moon, and a fifth one for the return journey. Chemical propellants in use today offer sufficient thrust to give the 150-foot ship the 24,000-mile-an-hour speed bursts that are necessary. The crew sits in a forward gondola.

would be created by nuclear-pile heat



sitting in a gondola 250 feet forward—from harmful radiation. Like the moon ship, this vehicle is assembled in and launched from the earth-satellite orbit. Mars and Venus are within its range. On return to earth orbit, it could be refueled and used again.



INTERPLANETARY SHIP of advanced design has TV robots with mechanical arms that can inspect and service the "hot" nuclear rear portion of the vehicle in flight. Once in a planet's orbit, it can launch small, manned rocket ships for a close-up look at the planet.

hicles is his own, but they are designed to come within the scope of this program. His first step is an automatic, unmanned, three-stage supply rocket, based on an advanced ICBM rocket. The Atlas is reported to be 80 feet long, and to have a thrust of 100,000 pounds, plus about 250,000 pounds from booster rockets to get its 80 tons of weight off the earth.

This is not enough power to launch his 126-foot rocket and boost its 11,000-pound payload into a 600-mile-high orbit. All the big rocket companies, however, have facilities for ground-testing rockets with a thrust of a *million* pounds or more.

Building blocks in space need men to put them together. The rocket power that sends up the unmanned supply ships could also boost the first spacemen into the same orbit. For this Ehricke offers a winged third stage that rides piggy back on top of the second stage. It would return to earth as a hypersonic glider.

Such a manned space ship is not just a dream. We actually have a prototype—in-the-building. It is the North American X-15, which the Air Force expects, before the year is out, may speed man and machine at speeds approaching 10,000 miles an hour at altitudes perhaps as high as 100 miles.

With men and materials in space, orbiting 600 miles above the earth, the construction of a more livable satellite becomes necessary. Shaped like a dumbbell, it is put together in the orbit, mainly from the fuel and oxidizer tanks of the automatic supply ships. Small rockets would set it into slow rotation, creating a pleasing artificial gravity of about one-third that on earth.

This is a more modest proposal for a space station than some that have been suggested, such as the "City in Space" of Darrell Romick, a scientist of the Goodyear Aircraft Company's astrophysics department, described in the May, 1956, issue of POPULAR SCIENCE. Ehricke believes, however, that his satellite platform is adequate as a service station for man's initial ventures into space—with destination moon next on the itinerary.

His lunar ship is strictly a reconnaissance vehicle for flights around the moon and back to the earth orbit. It also would

[*Continued on page 244*]

GEARSHIFT LEVER mounted on steering column imparts feeling of familiarity to the U. S. motorist. A welcome novelty in European cars is a synchronized first gear. Floor mat is rubber. Knob on door controls window vent.

Driver's report on

GM's German-Built Opel

Most Americanized of low-cost imports, it's supple and—by European standards—flossy

By Devon Francis

A SMALLISH car, with a surprising amount of grace, has begun to appear on U. S. highways. It looks fresh from a Detroit production line. It isn't. It's from West Germany, and its name is Opel. It's comfortable. It's eco-

OVERHEAD-VALVE ENGINE is "over-square," with 3.15-inch bore, 2.9 stroke. Opel's displacement is 90.8 cu. in., compression 7.5:1.

SEAT-HINGING, throwing cushion to left as well as forward, makes rear-seat entry easy. Front seats are contoured for riders' backs.

BUTTON-OPERATED CATCHES on doors reflect Detroit influence. Bulb between side windows is "side marker light" for parking.

TRUNK contains extraordinary space for low-cost import—20 cubic feet. Rubber-grommeted filler tube connects to 10.5-gallon tank.

nomical to run. And—now at least—it's hard to get.

There's good reason why the Opel looks like a domestic product—the styling is by General Motors. GM's stylists in Detroit collaborated with GM's factory in Russelsheim in fashioning the sheet metal. One of two cars that GM is importing from Europe, the Opel is sold through Buick dealers. The other one is the Vauxhall, marketed through Pontiac dealers.

The full pedigree of this two-door sedan is the Opel (pronounced O-pel, with equal emphasis on each syllable) Olympia-Rekord. As one of GM's belated entries in the little-foreign-car field in the U. S., it's competitive with the whopping-est seller among the imports, the Volkswagen (equally German).

As a European product, it also compares with France's Renault, England's Hillman and a dozen and a half other vest-pocket vehicles sold over here. Like most, the Opel has four cylinders. Like all, it goes a long way on a gallon of gas—an average 30 miles.

But there the comparison ends. I've driven the Opel. On city street and on turnpike, it handles differently from the other imports selling for less than $2,000. Despite modest poundage of 1,995, it has a weighty feel. Its 56-horsepower, overhead-valve, liquid-cooled engine requires considerably less shifting.

LOW-DRAFT VENTILATION is provided by cam lock holding open entire rear window on each side. Car height unloaded: 56.7 inches.

SHELF BEHIND REAR SEAT can hold hats, packages. Wraparound back window has 809 square inches of glass, windshield 937.

T-HANDLE ON DECK LID seemed to be car's only poorly designed hardware. Main structure is frameless, stiffened by heavy floor pan.

ENTRANCE-ROOM HEIGHT, from cushion to top of door, is more than 30 inches. For an import, trim has sparkle. Seats are extra-soft.

The clutch is soft. Changing gears through three forward speeds (as opposed to four in some of the other imports, notably the VW) is easy. The shift lever is mounted on the steering column. A U. S. motorist is at home with it.

With one passenger aboard, I reached an indicated (and almost true) 60 miles an hour in 22 seconds. For the information of those accustomed to a crackling 10 seconds in domestic products, that's pretty good. The VW requires 30 seconds. But then there's more than 50 pounds per horsepower in the VW, and only 35 in the Opel.

The top speed is modest. The car I drove, well run-in, leveled off just under a true 70. About its inner decoration:

By a European yardstick, the interior is plush. I found the panel free from those doorless-bin catch-alls that seem to be the hallmark of the less costly imports. Controls are nicely grouped. Dials, especially the ribbon-type speedometer, are easy to read. Visibility is superb.

The heater could stand improvement.

The hip-, leg- and head-room are adequate for four persons except in the back seat—where Europeans generally pay scant regard to passengers. The Opel's is a bit better than the Renault's, just about equal to the VW's. The bench front and rear seats provide 53 inches of hip room, 35 to 36 inches of headroom. The

leg room in front is 43 inches but that in the rear only 39.

The Opel is a delight to handle. For scooting in and out of traffic, the torque in second gear has authority, and on level ground the engine will not lug or buck above 15 miles an hour. At idle, this busy, short-stroke little job is so quiet that, in normal street noise, I was tempted to tap the accelerator to see if it was turning over.

As in all low-weight imports, steering is fast, with resulting high maneuverability. Braking is easy. And need I add that I squeezed into parking places, with room to spare, that I would not attempt with my modest-sized 1952 Ford? That's a result of the Opel's 100-inch wheelbase and overall length of only 174 inches.

Practically everything about the car is in the current U. S. mood, from the depressed-center steering wheel to the 15 inches of pure air between the radiator and front bumper. There's a wraparound windshield and rear window, too.

To the American motorist's eye, the hood and deck, as contrasted with most of the other imports in this price bracket, are in pleasant proportion to the rest of the car. A piece of chrome molding runs back from the front fender, to cascade toward the rear tread. Both the Buick Motor Division and GM Overseas Operations say the resemblance between this bit of ornamentation and Buick's traditional "sweep spear" is pure happenstance, which surely will rank among the year's most peculiar coincidences.

In bringing in the Opel and Vauxhall for domestic sale, GM has reversed a decision that was given publicity as late as 18 months ago. The corporation stuck to the notion that the U. S. motorist preferred a full-size, second-hand Detroit car to a small import. Two good reasons were behind that—to import cars would prejudice the sale of second-hand cars; and supplying parts and service for the imports would require stocking up dealers and training their mechanics.

But for five years the sales of foreign cars here have climbed steadily, and money is money, to GM as to everyone.

GM is importing not only the Opel Olympia-Rekord but a station wagon, the Opel Caravan, as well. Rumors persist that the corporation will bring in, presently, a bigger, six-cylinder, 81-horsepower Opel called the Kapitan.

Opel was an old name in German manufacture when GM bought out the company almost 30 years ago. Engines and suspensions, as well as bodies, inevitably show the Detroit influence. So does the practice of changing body styles on a four-year cycle. The current body is brand new, so it's a legitimate assumption that it won't be changed until 1962.

The Opel should be a cut above the bulk of the imports in performance and looks. It's priced higher. It sells in West Germany for 6,385 marks, or $1,522 at the current rate of exchange. It delivers shipside at New York and Gulf ports for $1,812.50, and in Los Angeles for $1,994.-64. To these sums must be added $175 on the showroom floor to cover the federal excise tax and dealer "preparation and handling" plus state and local taxes.

The station wagon delivers shipside in New York and Gulf ports for $2,194.45 and in Los Angeles for $2,376.59. The excise and dealer charges are somewhat more than for the sedan. Away from seaports there are, of course, additional transportation costs. Most of the difference between German and U. S. prices results from ocean shipping costs.

The Opel sedan is priced $442 beyond the biggest-selling European import, the Volkswagen, $342 beyond the Renault Dauphine and $448 beyond the British-built Ford Anglia.

Opel prices are hard. You can dicker on a Chevy, De Soto or, indeed, on a Buick. But not on an Opel. Reason: They're scarce. The Opel factory produced 229,600 cars in 1957, and sold them mostly in western Europe and Scandinavia. It may do a little better in 1958, but the present allotment to the U. S. is only 1,000 vehicles a month.

In the American tradition, there are options. To the following prices must be added dealer-installation charges: windshield washer $7.20; radio $83.55; antenna $10.25; back-up lights $3.15; outside mirror $3.75; bumper guards $8.15 front, and an equal amount for the rear. The heater is standard. Two-tone paint, not available on the sedan, is standard on the wagon.

For the prospective purchaser, the Opel has a plus, for free: The wife with a special allergy for the boxlike appearance of the average import is likely to say in the showroom, "Well, it's pretty." END

What We're Learning About Tornadoes

Every year more towns get hit by twisters. But now weather men have some clues to their cause —and are looking for a cure

By Edward D. Fales

LAST year was the worst tornado year on record. This year *could* be even worse. To quote one weather man: "If the trend continues, 1958 could be a blockbuster."

Until 1951 an average of 150 twisters per year were reported to the U. S. Weather Bureau. In 1951 there were 300. In the next three years the number skyrocketed. There were 690 in 1954. In 1955, 870; last year, nearly a thousand.

To top this off, our big cities and their sprawling suburbs are being hammered: Dallas, Worcester, Flint, Kansas City, Fargo are examples.

On some recent days twisters have come at a fantastic rate. As many as 28 have been officially reported in a single day. In Texas last April 3, 58 tornadoes were unofficially reported. "They're coming so fast and thick," one watcher moaned, "that we've lost count."

Some experts blame the tornado boom on shifts in air circulation. But Dr. Mor-

The stories about twisters are true. This happened in Ionia, Iowa, on April 23, 1948.

Tornadoes hit more often now, yet kill fewer people. Radar gets a big share of the credit

ris Tepper, the Weather Bureau's expert on tornado research, says: "There are many more people today to see—and get in the way of—tornadoes. The tornado that rolled harmlessly through a field 10 years ago today rolls through a shopping center."

Anyway, the fact remains: More towns and more people are getting hit.

Against this bleak background are two bright spots:

1. The Weather Bureau is fighting back. Soon it hopes to launch a "severe-storm laboratory" project that could lead to tornado control.

2. Fewer people are killed in spite of the sevenfold increase in twisters. Until 1951 deaths averaged about 225 a year—three deaths for every two tornadoes. But between 1951 and 1956 the death rate dropped to about 175 a year—one death in three tornadoes. For this you can thank luck plus the Weather Bureau's alert young Severe Weather Warning Service. In five years this service has saved, conservatively, 2,000 lives.

Helping the Weather Bureau are thousands of volunteer observers and dozens of college scientists. A tornado disaster today is treated like an air crash. Just as CAB inspectors swarm over a smashed plane, weather-research teams now swarm into tornado areas, examining bits of wreckage, interviewing witnesses.

Along with this, Weather Bureau observers are closing in on tornadoes. A few seasons ago observers were often 200 or 300 miles apart. Today competent volunteers may be stationed, with instruments, every 20 or 30 miles.

The facts. Here are some of the things we now know about twisters:

- They come usually from southwest or west; occasionally from the northwest.
- They breed when a warm, sticky south wind has been blowing for several hours—but a cold front is charging down from the northwest. Usually there's a thunderstorm, too.
- They mostly show up between three and seven p. m., yet can hit at any time.
- They can strike in any month. Winter tornadoes usually are limited to the Gulf states. In March they migrate north with spring. After July, they suddenly begin to quiet down.
- Tornado Alley stretches from Texas to Minnesota. Another path chops all across Dixie. Mountain areas and the West Coast are fairly immune.
- Some twisters are vicious, travel 300 miles or more, smashing town after town. Others give up after a few minutes' whirl.

The tricks that twisters play are part of American folklore. A farmer will swear that tornadoes follow roads and ditches. Some weather men think that this may be coincidence. Still, one recent twister actually appeared to change course to follow a road for a half-mile.

One may roar toward a house and suddenly leapfrog over it, leaving no more damage than a few bricks loosened in the chimney. Last year one charged down a driveway toward a farmhouse, turned and went *around* it before resuming course, just as if there had been a "Keep Off" sign on the grass.

Tornadoes sometimes travel in gangs, as many as six funnels jumping up and down at once. (If you're ever near a twister, keep a sharp eye out for its "sister"—another main funnel which can develop on one side.)

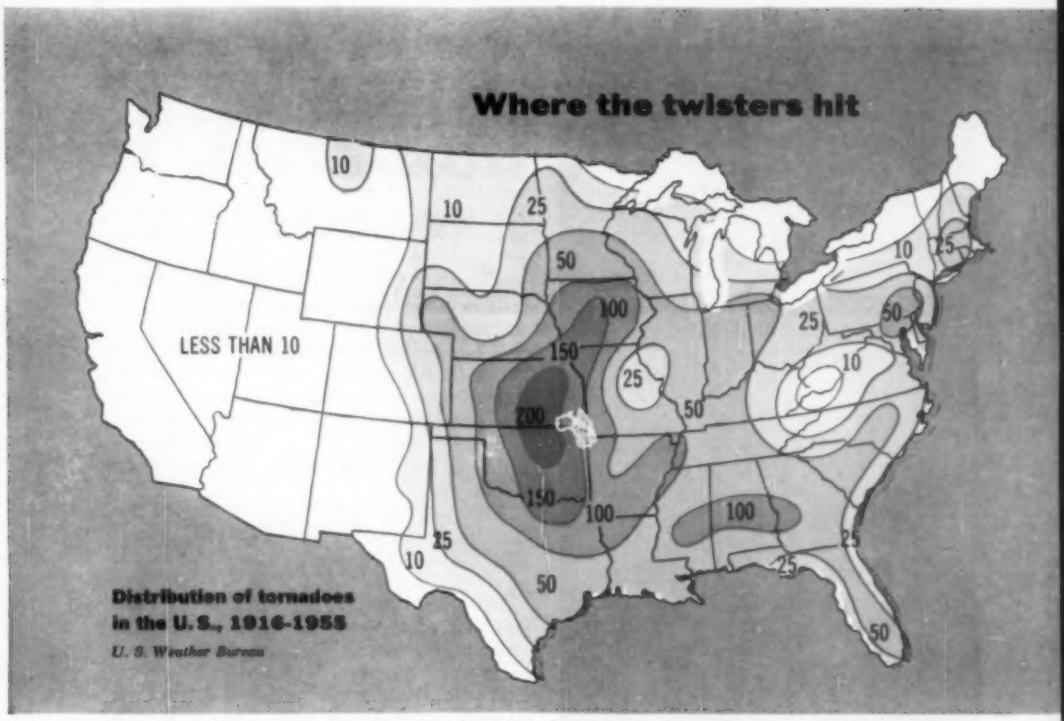
Anatomy of a twister. At the ground a funnel may be a giant whirlwind a mile wide or just a good-sized vacuum-cleaner nozzle—nine or 10 feet across. Usually it's 200 to 300 yards wide. Some appear to "hunt," as an elephant's trunk probes for peanuts. Air pressure inside the fun-

If a Tornado Comes Your Way . . .

The U.S. Weather Bureau issues a "tornado forecast" whenever tornado weather is developing. This means stand by: It *could* happen today.

When a funnel is actually spotted the "tornado warning" goes out. Warning time: 10 minutes to an hour.

If your county is named, get ready to duck. A good storm cellar is considered 100 percent safe. Even the average basement is fairly secure—if you crouch in the corner *nearest* to the approaching funnel.



Tornado Alley runs up the middle of the U. S.—but the terrible twisters can strike anywhere.

nel is very low, which is why tornado-struck buildings burst outward.

Suppose a funnel passes close to you. What do you hear and see?

The sound, as everyone knows who's ever been close to one, is like a fast freight train or a hundred airplanes. On a quiet day you may hear another sound —smashing timber.

A slashing wind may bend the trees, and horizontal *brown* rain (stained by mud being whirled through the air) may drive past your windows. If there's no rain you may have a pretty good view of the breath-taking gray funnel.

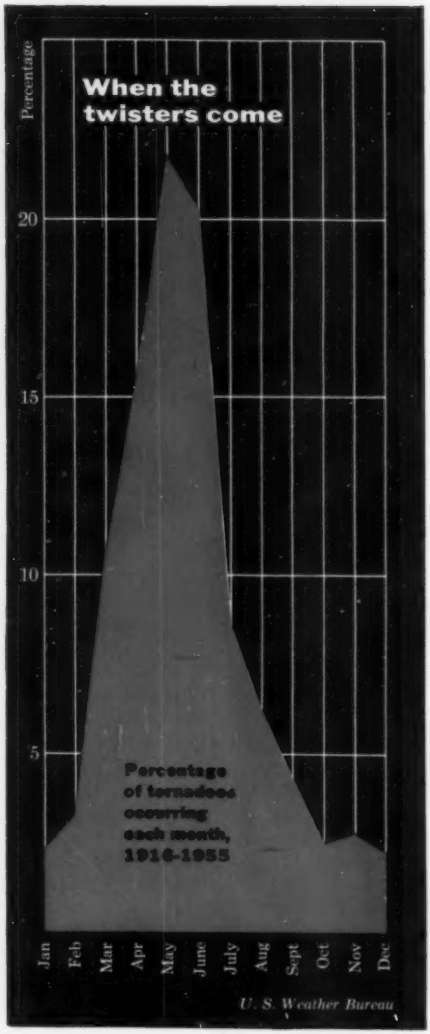
If the twister comes in a thunderstorm you may see endless flashes of lightning. This intense phenomenon is, in fact, one way scientists now study the funnels. Special "sferics" instruments now spot such lightning outbursts and follow tornadoes by triangulation—from as far as 200 miles away.

How fast do they whirl? Recent studies find no evidence of winds faster than 200 m. p. h. Forward speed averages 16 to 20 m. p. h. But some twisters move at turnpike speeds of 60 m. p. h., and one hotrod was clocked, unofficially, at 138. There are also slowpoke twisters that creep at walking speed, and one last year even stopped long enough to chew a hole in the ground with spinning wreckage. If *you* ever see a tornado that seems to stand still, duck. Chances are it's heading straight for you.

The best defense: early warning. Your greatest protection against tornadoes is radar, which can spot them 150 miles away. Today the Weather Bureau has radar at offices and airports in many states. In Tornado Alley some towns own and man their own radars.

But lately another device has come into wide use: the pressure-jump detector. Weather men have discovered curious lines of pressure that skid eastward ahead of a cold front. In some cases tornadoes form near those lines.

You can do some detecting by observing your own living-room barometer. Suddenly, after hours of rain, the instrument



will kick up a notch and you'll hear a peal of thunder. That's a pressure jump.

Now the Weather Bureau has special detectors installed in dozens of farms, and in police and fire stations. These sound a buzzer and flash a light when barometric pressure suddenly rises—and this sends a volunteer observer to the phone to notify the nearest Bureau. When a "jump line" is moving, the radar operators watch their scopes for the curious button-hook-shaped blips that may mean tornadoes.

What makes a tornado? Scientists now think that a tornado may be put into its dance by some vast force *pulling* through the atmosphere (as a spinning propeller, suddenly revved up—or revved down—pulls up little dust devils when a plane warms up).

This pulling force could be one of the narrow jet streams—high-altitude winds that zip eastward across America at speeds of 100 m. p. h. or more.

But this doesn't explain another puzzler. Anyone who has seen a weather map knows about "highs" and "lows," their centers several hundred miles apart. But now weather sleuths have discovered strange little highs and lows that can form side-by-side almost within a good-sized farm. These curious "micro lows" look like mere dimples on a weather map.

But they can be deadly when they form in twister weather. For out of these innocent-looking micro lows may come tornadoes.

Tornado control? If twisters come out of strange little disturbances only a few miles across, it seems reasonable to expect that cloud-seeding or some similar technique can prevent them.

Meteorologists hope Congress will okay $5,000,000 more a year for research to find out. Instead of ground observers 30 miles apart, the meteorologists want to station men and instruments only 10 miles apart in the busiest parts of Tornado Alley. These men would take readings on every foot of a tornado—beginning hours before it is born. And when the funnel forms, five or six planes would buzz around it—even over it to take radar photos down the funnel.

From this kind of massive study the Weather Bureau thinks it can, in five years, learn what tornadoes really are—and then, how to stop them. END

Coming: A Tornado Alarm for Your Home

Soon you will be able to buy, for a few dollars, a plug-in gadget that will give you a double warning—flash a red light and buzz—when tornadoes are about. It's activated by a pulse sent out from the power station.

If your eyes miss the signal your ears won't—then you can turn on your radio and listen for details.

Admiral Rickover tells how:

Russian Schools Can Teach Us a Lesson

How did Russia's educational system produce the know-how that launched Sputnik—and what can it teach us about weaknesses in our own schools? Below are highlights from an address by Rear Admiral H. G. Rickover, USN, Chief of the Naval Reactors Branch, Division of Reactor Development, of the U.S. Atomic Energy Commission.

THE powerful thrust of Sputnik's launching device did more than penetrate outer space. It also pierced the thick armor encasing our complacent faith in America's present and future technological supremacy.

It did greatest damage to our trust in the American educational system—up to now almost as sacrosanct as motherhood. Harsh words are being said about its methods no less than about its aims. For rightly, Sputnik has from the first been seen as a triumph of Russian education.

It has surprised us to find that Russia's intellectual elite does highly competent work despite authoritarian control in all, even the highest, educational and research institutions. Russia appears to have found a way of allowing superior minds freedom in the field of their special competence while denying them the right of political criticism.

Faced now with this formidable and ruthless adversary who has openly promised to "bury" us and who grows daily in industrial and military might—what are we to do?

First, I think, we must awaken America to the danger facing the nation—making public all the facts, and without soothing the impact of unpleasant truths. Sacrifices to give America strength in the race with Russia would be insignificant in view of our enormous margin of luxury spending.

Second, and equally important I believe, we must reverse our treatment of the scientist and trained professional. We had better stop calling scientists longhairs, eggheads, little men with beards. In the present mood of chastisement, scientists have been speaking up and telling us that such disparaging remarks hurt, and may discourage many a young man from choosing the hard intellectual road to science rather than the easy and pleasant road to business success and country-club living.

But merely spending a lot of money on scientists, scientific research and new military projects will not be enough. In final analysis trained manpower can only come out of a thoroughly reorganized educational system.

Much could be learned from Europe's experience in education, in particular, for Europe is old and wise at educating the young.

Because of ability to face facts squarely, Russian education for the past two decades has in reality been European education, but with all its classical, philosophical, nontechnical parts left out and with a heavy overlay of Marxist indoctrination.

By stripping down to what the Soviets consider the essentials, secondary schooling can be completed in 10 years instead of the usual 12 or 13 years in the rest of Europe. These two years saved enable the Russian student to begin training for his profession at 17.

The greatest confusion in any comparative study of education comes from the misconception of the worth of the American high school. We have always overvalued it. Merely because its graduates are approximately of the same age as European graduates of secondary schools, we keep thinking of the two as being, if not identical, at any rate comparable.

Yet the Russian 10-year school, for

[*Continued on page 248*]

The Blasting of Ripple Rock

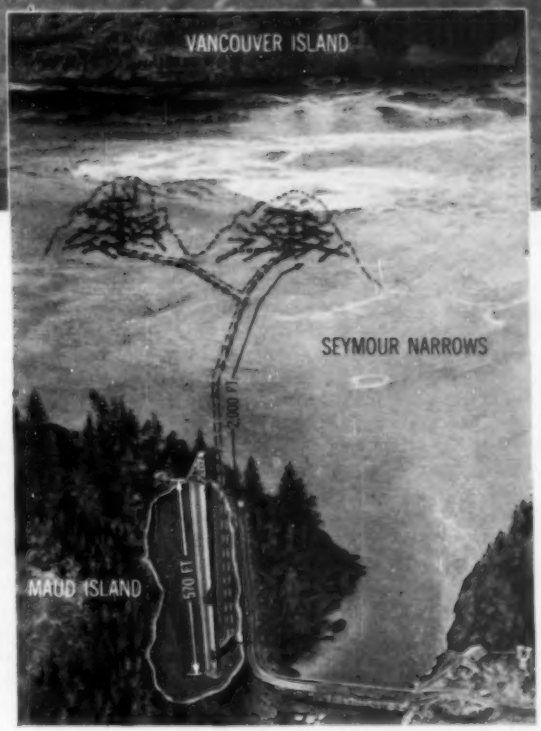
By Elliot Marple

SOMETIME within the next four to six weeks man's greatest non-atomic underwater explosion will be set off on a far stretch of the British Columbia coast in Seymour Narrows. If all goes well, a million and a half pounds of powder placed in caverns cut from solid rock will crack, shatter and hurl aside the twin underwater domes of Ripple Rock on the inside passage to Alaska. With this blast should disappear the worst hazard to navigation on the north Pacific Coast, a hazard that has sent more than 100 boats to the bottom and has taken the lives of 114 persons.

A $2½-million firecracker. Before the big blast is touched off, the handful of residents within a radius of three to four miles will be evacuated under directions of the Royal Canadian Mounted Police. The big pulp and plywood mill of Crown Zellerbach of Canada, only five miles away, will be shut down and evacuated. Nine miles away, storekeepers and residents at the town of Campbell River will stand by tensely, many of them with their doors and windows open as a precaution so that the shock will not break the glass.

Over a wide area, scientists and rubbernecks will press for the best possible view, safety considered. Motion-picture cameras will be placed up close, focused for the explosion, timed to start at a precise moment, then left unattended. Seismologists at carefully selected stations within a radius of 500 miles will be standing by their instruments to pick up a signal that

Canadian engineers are about to touch off a $2½-million firecracker in an attempt to demolish a navigation hazard that has long taken a deadly toll



How to blow up an undersea mountain

Mining crews burrowed below the water bed, and out to the two peaks. Then they riddled each peak with a network of tunnels. There's enough room to hold 1½ million lb. of ammonium nitrate, the explosive that caused the Texas City disaster. The job will take 30,000 cans of it, 300 to act as detonators. Finally, one day early in April, a project worker will light a match. A quarter million tons of rock will go up with an earth-shaking roar.

may give them new clues to the secrets of the earth's crust.

Ripple Rock is worth all this attention. Ask any mariner who has guided a vessel through Seymour Narrows, the passageway where Vancouver Island nudges close to the mainland. Here the broad, blue Georgia Strait narrows from 20 miles to a scant half-mile. In the middle of that half-mile lies Ripple Rock, an underwater mountain with two broad domes, one nine feet below the surface at low tide, the other 20 feet down.

A navigator's nightmare. Alone, neither Seymour Narrows nor Ripple Rock would be too serious. But four times a day the ebb and flow of tide sends the waters of the Pacific Ocean and Georgia Strait churning around the Rock in a deep, white torrent. Eddies, whirlpools and crosscurrents make navigation treacherous. To add to the hazard, ships must turn nearly 90 degrees to enter the Narrows from the south.

Skippers, even after a lifetime in these waters, never lose respect for the Rock. Said one experienced Canadian pilot: "After all these years, my hair stands on end every time I take a ship past Ripple Rock."

It's a common sight to see several vessels standing by at one end or other of the Narrows, waiting for favorable water. Only those with good speed—17 knots or better—try to buck the tide. Larger ocean vessels, deep-laden and heavy, wisely take the longer outside route around Vancouver Island.

No one knows just how many ships or lives have come to an end at Ripple Rock. The Canadian Department of Public Works, checking back to 1875, reported five big ships or barges sunk, 19 more damaged. In addition, more than 100 smaller vessels—fishing boats, tugs and yachts—have gone to the bottom. Since 1875 at least 114 lives have ended in Seymour Narrows.

The earliest recorded sinking—in 1875—was that of a United States warship, the Saranac, an 11-gun vessel of 2,150 tons' displacement. One of the Rock's latest victims, ironically, was the Canadian hydrographic survey ship, William J. Stewart, severely damaged in 1944.

Pulling the teeth of Ripple Rock is something mariners have talked about for years. But the question was always how, and at what expense. In 1931 the Canadian government held hearings. Curiously, the feeling was not unanimous against the old Rock. Business interests in Victoria, the capital of Vancouver Island, stood up firmly for Ripple Rock. To them the Rock was less a hazard to navigation and more a tremendous opportunity to fulfill a long-cherished dream: building a railroad connection to the mainland and on down to Vancouver. Victoria men figured that with Ripple Rock for foundation, a railroad bridge could be thrown across Seymour Narrows. But they had little to say on how a railroad could then thread its way down the mainland coast, broken as the shore is with steep mountains and long, deep-cut fiords. Today fast steamers and railroad-car ferries link Victoria and Nanaimo on Vancouver Island to the mainland.

The real impetus to blow up Ripple Rock came during the second World War. The United States was moving a heavy volume of military supplies and equipment to Alaska. As a war measure the Canadian cabinet ordered the removal of Ripple Rock and gave the assignment to the Department of Public Works.

Methods of leveling the peaks had been under study for 20 years. Placing heavy explosives on the underwater surface of the rock at slack tide was impractical. Drilling and blasting from a structure built on the rock was too risky. An underground tunnel from shore was then considered too costly. But a method was finally chosen: drilling and blasting from a floating plant to be moored over the rock. In 1942 the contract was let.

First a scale hydraulic model of the Narrows was built at the University of Washington, Seattle, to make sure that the drilling barge would stay afloat in the current. It was a good thing that the model was made. When a five-inch model of a barge was moved cautiously over Ripple Rock in the laboratory, the barge promptly took water and went to the bottom. Designs were modified and tested again and again. Finally when a satisfactory design was achieved, a barge 150 feet long was built and equipped with drilling gear.

take a ship past Ripple Rock"

In the summer of 1943 the barge was moved over Ripple Rock and there held against the surging current by six concrete anchors, each weighing 75 to 125 tons. But there was trouble from the first hour. The fast current set up heavy vibrations in the steel anchor cables. The vibrations made continuous drilling impossible. Worse, the vibrations set up stresses that broke a cable on the average of once every 48 hours. By the fall of 1943 so little had been accomplished that work was suspended.

Two years later the drilling barge was back on the job, this time held in place by overhead steel cables stretched from high land on either shore and anchored there in bed rock. The cables were stout, if nothing else—1¾ inches thick. Again, drilling and blasting started up, but work was slow. Drilling was possible only during fairly quiet water. The drill could sink a hole no more than five feet, on the average, and it proved impossible to come back at the next quiet water to find the hole and deepen it.

In two months only 139 holes were completed, and of these 46 were lost before they could be filled with powder and blasted; 93 went to an average depth of 5.7 feet. Even this achievement cost almost a million dollars. When money ran out, the job was called off. Somehow a better way had to be found.

In 1953, the National Research Council undertook new studies, as the result of continued pressure to get rid of Ripple Rock. People asked, why not one grand atomic explosion? But on that the answer was simple. An underwater atomic blast would send a large quantity of radioactive sea water aloft to contaminate a wide area.

Attention shifted toward drilling a tunnel from one side of Seymour Narrows under the sea and up into Ripple Rock. But first there was need to learn more about the nature of the Rock itself. For this, a long hole was cut by a diamond drill. From Maud Island on the east shore, the hole curved down under the channel and up into the center of the Rock—a total of 2,504 feet. The cores looked good. The rock was solid and safe to mine, and there was no significant flow of underground water.

DOING IT THE HARD WAY: Tunneling was the only answer. Every other method studied was a flop. Last time, they tried drilling down from a floating rig. It was too slow and tricky.

The Department of Public Works called in two eminent consulting engineers, Victor Dolmage and E. E. Mason, of Vancouver. Based on their plans and specifications a contract was let for $2,639,000. In February, 1956, drilling began on Maud Island. Steadily since then 60 hard-rock miners, working in three shifts around the clock, have punched their way down under the channel and up into the middle of the domes of Ripple Rock.

On Maud Island a mine shaft drops straight down 570 feet. Seven feet by 18 feet in cross-section, it contains three compartments, one with a hoist for men and equipment; a second with a hoist to take out broken rock and debris; a third section for pipes, power cables, ventilation and other service lines.

At the bottom of the shaft a tunnel takes off at a right angle and runs level for 2,000 feet until directly under the north rock. Another tunnel branches off to a similar spot under the south rock. Then a vertical shaft rises under each dome a distance of about 300 feet. Finally, small horizontal tunnels six feet by seven feet in cross-section spread out in each dome, with smaller entries and laterals fanning out to hold explosives in the roof of each dome.

Great care is taken to guard against cave-in or flooding. The horizontal tunnel under the channel has at least 100 feet of solid rock between the bottom of the sea and the top of the tunnel. In

[*Continued on page 252*]

The World's Most Pampered

A FEW blocks from the White House is an unobtrusive building at 1901 C Street. A uniformed policeman guards the entrance.

The building, the White House garage, houses 40 vehicles. Six of them are perhaps the world's most coddled cars: four used by President Eisenhower and two by the Secret Service.

To get into the garage, I first cleared with U. E. Baughman, Chief of the U. S. Secret Service and boss of James J. Rowley, special agent in charge of the Secret Service White House detail. Then I visited Rowley in his White House office. He telephoned Dieter Flohr, the President's chauffeur, that I was on my way over. Flohr in turn alerted the policeman on the garage door, who let me in only after I showed my White House press card, bearing my picture and fingerprint.

Here's the President's famous "goldfish bowl," a 1949 Lincoln with removable transparent plastic dome. The car was loaned to Queen Elizabeth during U. S. visit last fall.

Inside, I found most of the 40 vehicles that make up the White House motor fleet. Thirty of these constitute a pool of Lincolns, Mercurys and Fords. The White House staff uses the Mercurys and Fords; five Lincolns are reserved for the use of visiting dignitaries.

Besides the 30-car motor pool, there are a couple of pickup trucks, two Secret Service Cadillacs, four cars reserved for the President's personal use, and two for the First Lady. All but one of the cars—a 1953 Chrysler Crown Imperial seven-passenger limousine owned by Mrs. Eisenhower—are the property of the U. S. Government. The motor-pool jobs, like the First Lady's limousines, are stock models. So is one of the President's four cars—a black Series 75 Cadillac. But his other three cars and the two Cadillacs used by the Secret Service are very special numbers.

Dieter Flohr, wearing a mechanic's white coat over his business suit, showed me around. No ordinary chauffeur, he is a member of the Secret Service. Mr. Eisenhower is the fourth president whose life has rested in his careful hands.

Flohr and I stopped first, on our tour of the garage, beside one of the two Secret Service follow-up cars. These are specially built jobs with a running board on either side, a couple of steps in back, and handrails all around. This makes it easier for an agent to jump on or off the car while it's moving through crowds behind the President's car.

Both follow-up cars are 1956 Cadillac 75s. They are convertibles with midnight-blue bodies and beige canvas tops that match the beige leather upholstery. Each has two jump seats and can carry nine passengers. Each is equipped with a two-way radio, with a big red light and siren mounted on top of the left fender, and with a compartment for guns recessed into the back of the front seat. Unofficial estimates put the cost of each follow-up car at about $65,000.

Under a policy of impartiality, the President's specially built cars represent all the Big Three—a Lincoln, a Cadillac and a Chrysler. They are designed to

The autos and aircraft the President uses to cover enormous mileage are specially designed and rigidly maintained to cut risks to a minimum

Vehicles

By William McGaffin

enable the public to get a better view of the President and to provide maximum protection.

Mr. Eisenhower inherited the Lincoln, a 1949 model, from Mr. Truman. It is black, with red-leather upholstery, and is known as the "bubble-top"—its back seat is covered with a transparent plastic top through which the President can be clearly seen.

The President's Cadillac and Chrysler are both black 1955 models with white sidewall tubeless tires. (The tires, standard heavy-duty models, are changed every 10,000 to 12,000 miles as a safety measure).

The Cadillac is a series 75 limousine—but the top has been replaced to take a sliding roof panel (giving the President plenty of room to stand up while riding in parades). It has blue upholstery and is air-conditioned.

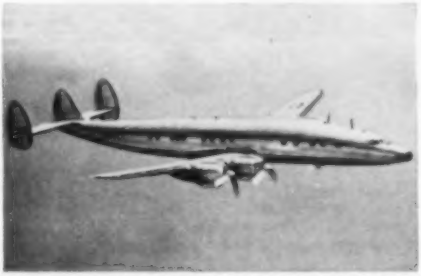
The President, who normally sits on the right-hand side of the back seat with his guest on the left, has a variety of pushbuttons to play with. These work the radio, raise and lower the windows on either side and the glass partition between front and rear seats.

There is no intercom system and the President's conversation in the back cannot be heard in the front seat. When the President wants to talk to Flohr or Secret Service Agent Rowley, who rides beside Flohr, he lowers the glass partition and calls to them.

"The wind coming in our side vents sometimes makes so much noise he has to call a couple of times before we hear him," said Rowley. "It gives him a soundproof conference room."

The glass in the car is bulletproof and the body is reinforced with nylon armor plate. This lightweight material affords as good protection as the steel armor plate that was used in Mr. Roosevelt's cars, without dragging down the speed. FDR's cars, loaded with heavy steel, had a maximum speed of only about 55.

The car has a two-way radio, like the Secret Service cars, and it is plotted from a control base (it uses a different identifying call each time it goes out) from the minute it leaves until it arrives. If the car ever had an accident, the control base would know about it within seconds.



Columbine III, President's personal plane, is a four-engined Super Connie with many special features. It cruises at 350, sleeps 15, could fly to Europe without refueling.

The Chrysler, with grayish-brown upholstery, is a Crown Imperial built exactly like the Cadillac. The only difference in the two is that the sliding roof panel on the Chrysler is manually operated. Flohr had to give it a couple of good hard tugs to get it open the day I saw it.

Mr. Eisenhower, busy conferring in the back seat of his car, never drives himself. Not even on the Gettysburg farm, where he gets about in a Crosley jeep-type vehicle with a fringed canvas top.

I asked Flohr, Rowley and James Hagerty, the President's press secretary, what specific precautions the President's driver takes beyond normal good chauffeuring. This was the answer I got:

Under policy of impartiality the President uses cars

"I don't bull my way through traffic or take advantage of other people's rights," said Flohr. "If there's any doubt as to who has the right of way, I wait."

The Secret Service has devised a technique for driving the President that pleases both him and them. He does not like to have a motorcycle escort—which suits the Secret Service. Reason: An escort of screaming motorcycles makes him dangerously conspicuous.

This is one of the President's two helicopters. They are four-place craft, but for improved performance, safety and range, they never carry more than pilot and two passengers.

So the President's car is unescorted and it stops for traffic lights just like any other car. For safety's sake, however, there is a Secret Service follow-up car right behind the President wherever he goes. And in Washington there is a Metropolitan police car behind the Secret Service car.

Hagerty noted that Flohr, once on the open road, makes a point of getting by fast when he overtakes another car. This is to avoid possible accidents. If the pass were made at a slower speed, the driver of the other car might recognize who was riding alongside him and inadvertently swing his car into the President's.

Whenever the President is going to fly some place, the cars are sent on ahead. The Secret Service insists on this so that they can make dry runs to the different places the President will want to go. This gives them a chance to find the way in advance and avoid the embarrassment of stopping to consult a road map with the President aboard. As a security measure they try never to take the same route twice in succession.

Dieter Flohr knows enough about the cars he drives to fix them when they break down in out-of-the-way spots. There have been breakdowns—but never while the President was in the car.

Major maintenance in Washington is handled by authorized dealers. Ford and Chrysler each has a master mechanic residing in Washington who has had security clearance and who supervises the repairs. The Cadillacs are taken to the Capitol Cadillac Co. at 1222 Twenty-second St., N.W., where Floyd Akers, the company president, supervises repairs.

Dieter Flohr, in his capacity as Secret Service man, has an additional responsibility: He must make certain that no one has booby-trapped the cars. He takes no chances—although the cars are kept under 24-hour guard both in Washington and on the road, which means long odds against anyone's being able to tie a bomb to the starter.

"The first thing I do in the morning," said Flohr, "is open the hood. I check the battery, the relays and the wiring. After I'm satisfied, I start it up." His whole technique each day is designed to make sure that if by some remote chance the car is going to blow up, it will happen with only Flohr in it.

Most of the President's travel is now done by air—his favorite mode of going places. The planes might well be called the world's most pampered flying machines.

In a terminal of the Military Air Transport Service near Washington, D. C., squats a four-engined Super Constellation. It's triple-tailed. It's sleek. It's fast. You can see its counterparts over land and sea every day.

The MATS airplane in question looks just like them. But it isn't. Beneath a private compartment is extra floor bracing, built to take more than 11 times the force of gravity. The compartment contains a special chair, padded with three-inch foam-rubber cushions. The chair, which swivels, would be turned so that its occupant faced the rear in case of a forced landing.

The airplane is the Columbine III, President Eisenhower's personal transport. It is one of nine Constellations in the V. I. P. fleet, and is always gassed up

and ready to go on the shortest notice.

The immediate White House air fleet consists too of an older Constellation—Columbine II—two twin-engine Aero Commanders and two Bell H-47 helicopters.

Columbine II, the smaller of the two Presidential planes, has a cruising speed of 300 miles an hour, compared with 350 for Columbine III.

Maximum permissible gross weight at takeoff for Columbine II is 107,000 pounds compared with 133,000 pounds for its big sister.

Columbine II could not fly to Europe without refueling en route. Columbine III could. But as a safety measure it was brought down to refuel on the way both in 1955 when the President flew to the summit conference in Geneva, and again last December when he flew to the NATO conference in Paris.

Each plane is equipped with radio-telephone and radio-teletype that can be used in flight. Each has an electric refrigerator and electric stove. An auxiliary power unit, run by a gas turbine in the tail of each plane, supplies electricity to give the planes complete independence in the most antiquated airports.

Col. William G. Draper, the President's pilot, briefed me on this.

"Some of the fields we hit in the South and West have not been used by the major airlines for years," he said. "One problem of the commercial airliners that follow us with the press is the lack of ground power units in these airports. They must have one to get the planes started again. So they truck one in along with a set of passenger steps the day before we arrive.

"But we can start our engines with our built-in power unit. We can run our lights with it and cook meals while we are on the ground. And we have built-in steps that we can lower out of the plane."

The Columbine II sometimes is used in preference to its big sister, said Draper, because it can get into smaller airports.

The Columbine III can sleep a total of 15 persons—two on the day beds in the President's private compartment, eight in the four upper and lower bunks in the White House staff quarters, and five in the crew's quarters.

On long trips, a third pilot is often taken along. Sometimes, as on trips to Europe, a whole extra crew is carried. It takes a crew of seven to fly the President. The plane also carries four enlisted men who guard it at airports away from Washington, and four Secret Service men who guard the President.

Engines on the plane are changed every 600 hours—compared with the 1,200 hours the always-careful Air Force feels it can normally get out of its engines before a change. The plane is flown out to the Lockheed plant at Ontario, Cal., every thousand hours for a thorough overhaul.

Maintenance is made easier, Draper said, by a gadget called the Sperry Engine Analyzer that checks ignition in flight.

Before this gadget, which came in with the Columbine III, "We used to have to change all the plugs on an engine that was running rough and test till we found the trouble," Draper said. "There are two plugs per cylinder, 18 cylinders per engine, and four engines on the plane—a total of 144 plugs. It used to be an all-day job to change the plugs."

But what if, in spite of everything,

The Chief Executive's 92-foot cruiser was formerly an escort for President Truman's yacht, Williamsburg. It has been renamed for one of the Eisenhower granddaughters.

an emergency did develop? What if a forced landing became necessary?

Well, for one thing, there would be no waiting until the plane was overdue before someone went to look for it. Using the identifying call, "Air Force One," Draper checks in at close intervals with ground-control points. His course is carefully plotted from the minute he leaves

until he arrives. When the plane crosses the ocean, a whole system of air-rescue planes and ships is set up across open water.

Mae West lifebelts are carried for everyone on board along with three life rafts, each capable of holding 20 persons.

For a quick exit, if the airplane were forced down, the President would slide down the escape chute from his compartment. This is made of a rubberized material and, like the life rafts, can be quickly inflated with cartridges.

The President does a lot of reading while in flight. He also plays bridge, takes naps, and goes up to the pilot's compartment. He learned to fly a plane in the Philippines before World War II but he has not kept up his license.

Colonel Draper has had some mishaps, despite the elaborate precautions taken, while the President has been along. Fortunately, they have been minor ones.

Three incidents stand out in the 37-year-old colonel's mind. There was the time in 1951 when Mr. Eisenhower was still in Europe with NATO. They had just landed one day at Luxembourg when one of two wheels tore loose on the right side of the landing gear and rolled merrily down the runway. Investigation disclosed that not sabotage but a crazy mistake was responsible for the incident. A B-26 wheel, almost identical with the wheel of Mr. Eisenhower's Constellation, had been put on the plane by mistake. The odd wheel could not take the Connie's extra weight.

The second incident occurred on the way to Augusta, Ga., in the spring of 1955. The amplifier of the automatic pilot suddenly began to smoke. Draper and his crew worked fast. They cut the recirculation fan, turned off the electrical system and came down quickly. Luckily they were only 10 minutes out of Augusta and they managed to make it in without even having to alert the President.

More than anything else, Draper confided, they worry about the danger of fire. That's why they carry smoke masks and parachutes for the President and other passengers as well as the crew.

"I would never ask the President to jump, however," said Draper, "except in the most extreme emergency—such as an uncontrollable fire at 18,000 feet."

The third incident occurred on the way back from the Bermuda conference in March of 1957. The cabin air pressure failed shortly out of Bermuda while the plane was flying at 10,000 feet. After considering his alternatives and checking with the President's doctor, Draper dropped down to 2,000 feet with a prayer that the weather would stay good all the way to Washington.

The plane arrived in Washington without Mr. Eisenhower's suspecting anything was amiss.

The President's pilot, like his chauffeur, takes endless precautions. All baggage has to be opened for inspection before it goes aboard. All the food, too, is inspected. Colonel Draper and his copilot, Lt. Col. Bill Thomas, always eat two hours apart while on a journey—as a precaution against both being incapacitated by poisoning at the same time. The poisoning they have to guard against is not only that of a saboteur. It could be accidental.

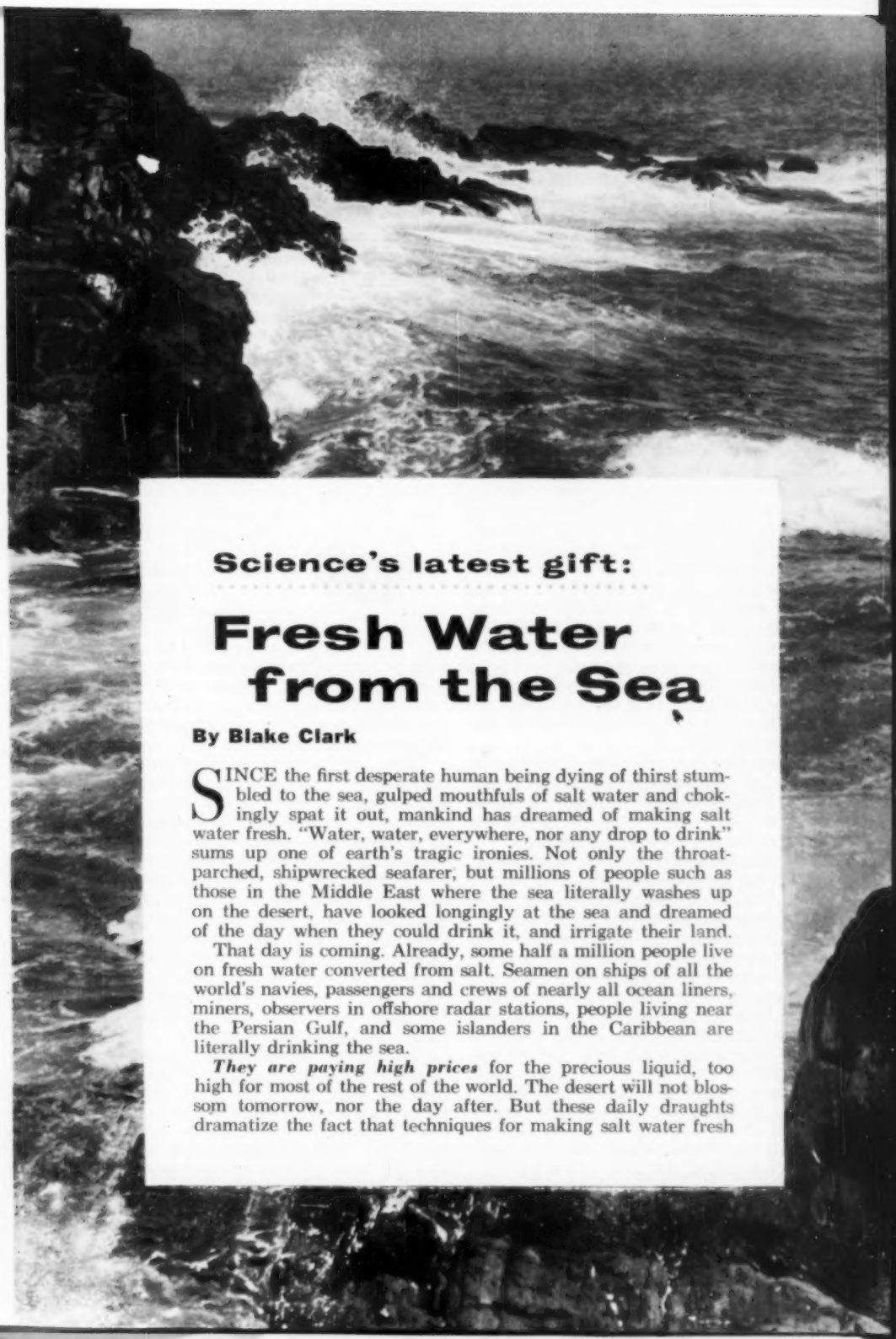
Thirty-four-year-old Maj. Joseph E. Barrett flies the helicopter the President uses. Capt. Lawrence R. Cummings flies the other one. Barrett carries the President and a Secret Service man. Cummings carries the President's doctor and another Secret Service man. Each copter could carry three passengers plus the pilot but is limited to two passengers to improve performance and safety margins. Also, they can carry more fuel, doubling their range to about 150 miles.

"Do you have special forced-landing training?" I asked Major Barrett.

He smiled. "We average 50 power-off landings a month." He hastened to add that he had been flying helicopters for years and had never had an engine failure. But he and Cummings keep in practice just the same because the copters are single-engine jobs.

The normal cruising speed of the President's helicopter is 90 miles an hour. It does not carry a parachute for him because it would not be feasible to try to use a chute at the heights it travels—1,000 to 1,500 feet.

Major Barrett makes certain, however, that there are safe spots to come down on before he takes the President up. He does this by surveying the route in advance, first by car, and then by several dry runs with the helicopter until he has found the best way to go. END



Science's latest gift:

Fresh Water from the Sea

By Blake Clark

SINCE the first desperate human being dying of thirst stumbled to the sea, gulped mouthfuls of salt water and chokingly spat it out, mankind has dreamed of making salt water fresh. "Water, water, everywhere, nor any drop to drink" sums up one of earth's tragic ironies. Not only the throat-parched, shipwrecked seafarer, but millions of people such as those in the Middle East where the sea literally washes up on the desert, have looked longingly at the sea and dreamed of the day when they could drink it, and irrigate their land.

That day is coming. Already, some half a million people live on fresh water converted from salt. Seamen on ships of all the world's navies, passengers and crews of nearly all ocean liners, miners, observers in offshore radar stations, people living near the Persian Gulf, and some islanders in the Caribbean are literally drinking the sea.

They are paying high prices for the precious liquid, too high for most of the rest of the world. The desert will not blossom tomorrow, nor the day after. But these daily draughts dramatize the fact that techniques for making salt water fresh

We take sips compared with industry's gulps . . . A

are being perfected. Success cannot come too soon. The need is tremendous.

At an ever-faster rate our civilization slakes its thirst on available sources. Scientists estimate that a person needs only about 20 gallons of water a day. But in the United States each of us drinks two quarts to a gallon daily, uses five gallons to brush teeth, shave and wash hands, sends out four with each flush of the toilet, takes 25 with a tub bath and five for every minute of a shower. And air conditioning, garbage disposals, automatic dishwashers and lawn sprinklers are annually running up our water consumption by about a gallon a day per person.

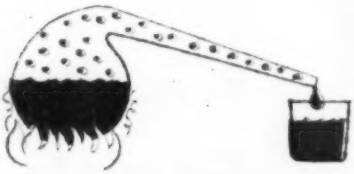
We individuals, however, take only a few sips compared to the gulps of industry. Its maw is insatiable. Three hundred gallons of water go to make a barrel of beer, 65,000 gallons for a ton of steel. A single Texas paper mill pours in 22 million gallons a day. One oil refinery drinks up as much as all the 915,000 residents of Cleveland. Industry swallows 47 per cent of our water; irrigation takes 45 percent, and individuals take only eight percent. For all purposes, we use 250 billion gallons a day now—six times as much as in 1900 and half what we are expected to consume in 1975.

Water shortage threatens our nation's dream of unlimited industrial development. Diminishing sources mock the hopes of many arid Midwest and Southwest communities for industrial expansion. Experts describe the water problem as acute in Texas, New Mexico, Arizona, Colorado, Utah, Oklahoma and Kansas, fair to moderately serious in Nevada, Montana, Wyoming, North and South Dakota and Nebraska. Many communities, even in our eastern states, are using water faster than it is being replaced in their reservoirs. Last year the precious liquid was rationed in more than 1,000 parched towns. More rationing is inevitable unless new sources are found.

This is only the United States. Water supply is a key factor in the economic growth of any country. In Israel, Greece and all the Middle East, Australia and the West Indies, the need, always pressing, is becoming crucial. Arid and semi-arid areas cover an estimated one-third of the world's surface; their development awaits water to make the deserts green.

While we will tap new fresh-water sources and also doubtless reduce our present lavish waste, there is a limit to the amount these means will provide. But chemists, mechanical and industrial engineers, inventors and mathematicians in many parts of the world are rushing down different avenues in a friendly treasure hunt to find a way to de-salt sea water and deliver this gift to mankind. Here are some of the roads they are taking:

Among the different methods, the most advanced is distillation: the simple process of boiling the salt water and drawing off the steam, which when cooled



is pure water. Numerous manufacturers here and abroad have made such evaporating equipment for years, chiefly for use on ships at sea. All navies and virtually all passenger ships use it.

These mechanical oases, enlarged to convert from 100,000 to three million gallons a day, are now a great boon to the people of Kuwait, oil-rich principality on the Persian Gulf, where the thermometer often rises above 130 degrees. For centuries Kuwaitis soothed their parched throats with brackish trickles from hand-dug wells. Then, in 1950, the Kuwait Oil Company, using six Westinghouse evaporators, daily converted 720,000 gallons of salt water to drinking water. Just one sip was enough to convince the local ruler, who ordered 10 of the miraculous machines for his capital city.

Persian Gulf water is some of the saltiest anywhere, containing 40,000 parts of dissolved salts per million parts of water, whereas most ocean water is 35,000 parts salt, Chesapeake Bay is 15,000 and the Baltic Sea 7,000. Drinking water should have less than 1,000, preferably less than 500. In Kuwait the evaporators produce water of less than 100 parts per million of salt, and the entire population of

barrel of beer: 300 gallons. A ton of steel: 65,000

207,000 enjoys the modern miracle of sweet water—5,000,000 gallons a day—converted from the salty sea.

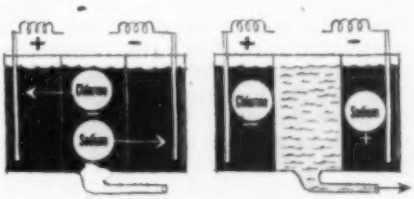
Equally dramatic is the job distillers are doing for the Netherlands West Indies, Curaçao and Aruba. Situated in the Caribbean some 60 miles north of the Venezuelan coast, these islands are extremely dry spots on the earth's surface. Rain evaporates almost as soon as it hits the sun-heated soil, or it streams from the rocky hills into the sea. Only a small percentage seeps into the local underground water reservoirs. In the dry season, water formerly sold for $1 to $10 a ton, depending upon the severity of the drought.

Then, as later on Kuwait, the oil industry introduced water conversion to these islands. Distilleries now produce a million tons a year for each community; this year the largest single installation in the world will begin to convert 2,700,000 gallons a day. American investors are putting up 5½ million dollars for an Aruba-located caustic-soda plant which could not exist without this supply of water. Also under construction is a 10-acre hydroponic farm to grow vegetables for the island at considerably lower cost than their present import by plane. Thus fresh water from the sea is helping Aruba attract investors, develop local industry and provide work for its people.

Desperately as the people of these remote, arid areas need this water, before it is widely used it will have to be competitive in price with existing supplies of fresh water. The Office of Saline Water of the Department of the Interior estimates that the most that cities can afford is 35¢ per 1,000 gallons, and irrigated farms must have it for no more than 13¢. Cost to date is far in excess of those figures.

Obviously, the first users of converted water will be industries. The process began here in 1955, when the Pacific Gas and Electric Company of San Francisco completed a generating plant at Morro Bay, Cal., where they are daily converting some 30,000 gallons of sea water to the very high purity needed for use in their boilers. The sweet water costs the company $1.96 for 1,000 gallons.

Fast upon the heels of the distillers are the developers of an entirely different technique, the new membrane process, which exploits the electrical characteris-



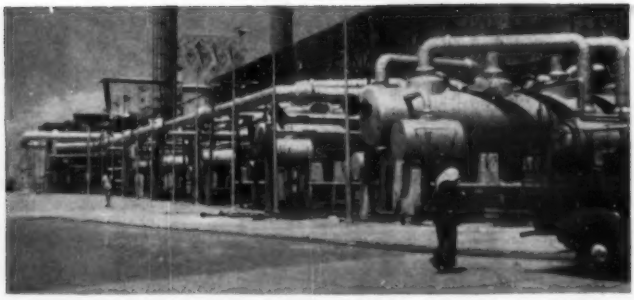
tics of the minerals in saline water. Salt consists of sodium and chlorine. Sodium particles, or ions, carry a positive electrical charge, chloride ions a negative charge. If the water is run between two electrically charged poles, one positive, the other negative, sodium ions move toward the negative pole, chloride toward the positive, leaving demineralized water.

The saline water flows in narrow passages of wafer-thin parchment or plastic sheets called membranes, electrically treated to permit the ions to go through but not come back. One membrane is treated to permit the sodium to go through, the other the chloride. The result is alternate compartments, one fresh water, the other a heavy concentrate of salt water.

A standard membrane unit consists of 300 of these ion-transfer membranes, each 18 by 20 inches, which form the walls of 300 one-millimeter-thick water compartments. In 150 of these compartments, the saline water is being purified and in the other 150, which alternate, the salts are being accumulated. The unit processes 20 gallons a minute, separating it into about two-thirds purified water and one-third brine. It runs 24 hours a day with little attention and hardly any maintenance.

While the expense of distilling is approximately the same, however salty the

NEXT MONTH: *You may be a suburbanite today, and a city dweller tomorrow —without moving from where you are. So say the population experts. Read, "Will a Super-City Swallow Your Town?" in April PS.*



SEA-WATER EVAPORATOR in oil-rich, water-poor Kuwait on the Persian Gulf is one of 10 that yield a total of 1.2 million gallons of fresh water daily. A huge plant now being built will produce 2.5 million gallons.

water, the cost of the plant and of the electricity needed in the membrane method declines with the salt content. This process is particularly good, then, for water that is brackish, or a third to a thirtieth as salty as sea water. Millions of gallons of brackish water almost good enough for men and animals to drink underlie huge areas of land in our Southwest as well as in the Middle East, Africa and Australia. The membrane process holds its greatest promise for such areas.

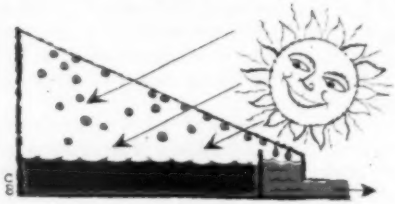
The membrane which is the key to the leading process was developed and patented by Walter Juda and Wayne McRae, electrochemists, of Cambridge, Mass. Backed by the American Research and Development Corp., which finances worthy though speculative ventures, their firm, Ionics, Inc., now has 20 purifiers producing the entire supply of drinking and cooking water for some 30,000 people in places ranging from the island of Bahrein in the Persian Gulf to a remote radar base at Havre, Montana.

One of the Ionics units is on its way to desert-working crews of oil men drilling in the southern Libyan desert. Three others work around the clock to meet the daily drinking, cooking, washing and laundry needs of some 100 Air Force men isolated on the three Texas Towers, the man-made concrete-and-steel islands anchored far out in the Atlantic off our east coast. Virtually unattended, the demineralizers silently pour hundreds of gallons a day into immense storage tanks.

South African scientists working for the gold-mining companies of the Orange Free State have independently created their own membrane system. They did it as a means of solving one of their major problems—disposing of the large volumes of brackish water in the mines. This acrid liquid is unfit for use in homes and cannot be emptied onto farmland without damaging the soil. Mines have been forced to bring it up and evaporate it in tremendous natural pans and specially constructed dams. This has meant buying vast areas of land and building miles of conduits. Now the available land is almost used up. Water to be evaporated has increased in the past two years from 13 million to 18 million gallons a day.

Financed by the Anglo-American Corp. of South Africa Ltd., a holding company for the principal mining interests of the Orange Free State, scientists of the South African Council for Scientific and Industrial Research are now building the biggest membrane-type operation yet—to treat three million gallons a day. The cost—35 cents per thousand gallons—is the cheapest so far for this process. Said a spokesman for the South Africans: "Lessons learned from the operation of the big plant will lead to the construction of many plants supplying water to towns, power stations, stock farmers, mines and others in areas now considered useless desert. Eventually it may be possible so to cheapen costs that saline waters can be purified for use for irrigation."

The sun every day draws up billions of barrels of water, distilling it in the process. Why not catch some of it on the way and bring it back? This, in effect, is



what a number of people are doing with the solar stills.

A leader in this field is Dr. Maria Telkes, the attractive blonde director of New York University's Solar Laboratory. During the early part of World

[*Continued on page 266*]

From the labs...

Porcelain Panel that Heats a House

New kinds of appliances, too, are being developed from this low-cost electric heating unit

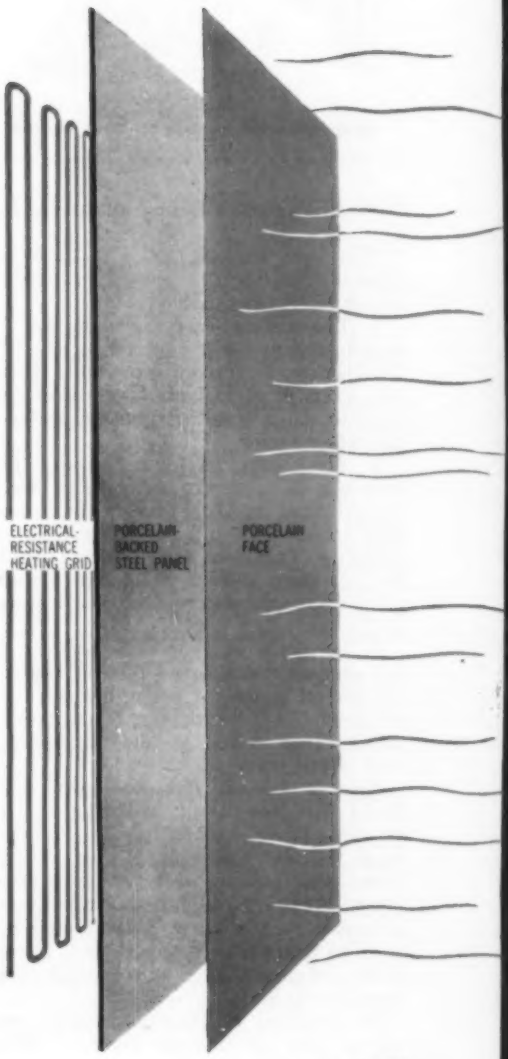
KICKING around half a dozen big product-development labs right now is an unusual new kind of electrical device. Basically it's a heater, but it promises to make its way into your home in any one of many forms:

- Room heater, warming your house better and possibly cheaper than your furnace does now
- Cookstove, with a flat smooth surface unbroken by burners
- Oven
- Hot-water heater
- Washing machine that keeps the wash-water hot
- Clothes dryer
- Automatic cooking pot
- Hair dryer
- Heated bathtub

Lots of uses for one kind of electric heater? That's because it's such a simple idea, adaptable to almost any heat need.

Good old porcelain. This heater is a panel of porcelain enamel—glass fused to sheet steel—the stuff ranges, washers, pots and bathtubs are made from. But the back of the panel has a grid pattern of aluminum fused to it. This grid is the heating element. Plug in the wires connected to it and its electrical resistance generates heat, which is radiated by the glassy front surface of the panel. The glass coating is an excellent electrical insulator, so you can't get a shock.

Heating is the latest new use for porcelain, making this ancient invention one of the hottest materials—figuratively as well as literally—for modern technology. Jet-engine parts are made from it, and so are the newest kind of electric lights



Wherever porcelain is used—washers, dryers, stoves—heat can

Wall-colored panels to heat rooms

Clothes washer that keeps water warm

(Sylvania's electroluminescent panels, PS, Jan. '57).

Why get excited about a porcelain heater? The usual reason—it promises a better job for less money:

1. The current-carrying grid can be practically any size, spreading out the heat source. In a room heater this makes for evenly distributed, comfortable warmth. In a hot-water heater, it heats the water faster.

2. The heating grid is very cheap. The pair of grids needed for a hot-water heater should come to 25 cents; the units now used in an electric water heater cost *six dollars*. (This does not count the cost of the porcelain sheets, which are already parts of present-day water heaters, stoves and so on.)

3. Porcelain is simple to produce in any shape—flat sheets for room heaters, cylindrical tanks for water heaters, "tin helmets" for hair dryers. The heating grid is fused on last, and follows the contour of the porcelain.

How it started. The idea came from Basil A. Needham, a low-pressure, smooth-talking super-salesman who has made a good thing out of the electric home-heating business. Shortly after World War II, Needham stumbled across a French electric heater originally developed to warm the Maginot Line. It was a sheet of special glass with heating wires fused to the back.

He acquired U. S. patent rights and set up the Continental Radiant Glass Heating Corp. (PS, Sept. '54), a thriving company which last year sold $5,000,000 worth of the units.

The Glassheat unit works fine—but the patent has now run out. To keep his competitive edge, Needham needed a new patent. The porcelain heater is it.

Needham is not an engineer, and his company has no research laboratory. So a number of people in a number of places developed his idea. He hired independent engineering consultants, also got materials suppliers to help (Allegheny Ludlum worked out the steel formula, a porcelain company specified the "frit").

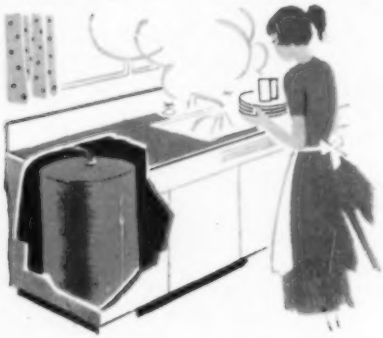
Big problem was getting the heating element to stick to the back of the steel panel. Needham is intentionally vague about how he solved it, but the process is apparently similar to silk-screen printing.

A mask is placed over the porcelain sheet (which has a porcelain coating back and front), and molten aluminum is sprayed through the mask onto the sheet. The sheet is baked and the mask etched away, leaving aluminum fused on in the grid pattern. Finally, terminal lugs are soldered to the grid and the whole thing is sealed with silicone.

However he does it, the porcelain heaters work—and somewhat better than the old glass units did:

- They heat up faster—attaining nearly 200 degrees F. in one minute, more than 300 degrees in 10 minutes.
- Most of the heat comes out the front,

now be added at a fraction of the cost of old electric units



Low-cost water heater that works fast

Quiet hair dryer—no blower needed

which runs 50 percent hotter than the back.

- The porcelain can be made in any color—to match house walls—although pastel shades work best.
- The new units are cheaper to make. A 1,200-watt (5,000-BTU) porcelain heater will sell for the same price as a 1,000-watt (3,400-BTU) glass unit.

Why electrical heat? The improved radiant panel adds force to the arguments for burning electricity to warm your house. The case is pretty strong already, and promises to become stronger.

- Comfort. Each room has its own heat source, individually controlled. The heat is radiant heat—like that from the sun—and is generally considered the most comfortable kind.
- Safety and convenience. There's no flame, no smoke, no dust.
- Economy. First cost is sharply lower than that of a conventional furnace—mainly because there is no furnace (nor chimney, pipes, blowers, ductwork). Savings are greatest for new houses designed for panel heat, but are considerable for older houses, too. Operating economy is not so clearly established. Needham says that his panel system in a heavily insulated house is competitive wherever the oil price is 15 cents or more a gallon while the electric rate is two cents or less a kilowatt-hour (to quantity users). This situation applies over much of the U. S.

The long-run odds are with electricity, anyway. Already it heats 280,000 U. S. homes. Oil and gas prices have climbed sharply in recent years; electric rates have been fairly stable. And the utilities are hot after the heating business. They need it to boost wintertime consumption and balance their summertime load from air conditioners.

Air conditioning brings up the obvious disadvantage of the radiant-heat panels. They can't do double duty by cooling your house in summer, a handicap they share with most steam and hot-water heating plants. Warm-air and electric heat-pump systems can do both jobs.

When? The new porcelain heat panels are now on the market. The first models are already warming radar technicians on the DEW Line in northern Canada. Others have been installed in a few U. S. homes and schools. Regular production began early this year.

The other appliances aren't available yet. Needham does not plan to make them, instead wants to license his patents. He has nibbles from some of the big manufacturers.

Needham predicts that the hot-water heater should be ready for the market in a year or so—at a price 30 percent lower than comparable models. And a $25 clothes dryer is a possibility.

But Needham's eye is sharpest for the home-heating business. He says, "Inside of five years, no one will build a house with anything *but* electric heat."

Over-optimistic? Maybe. But it's in the right direction.—*Martin Mann.*

Why Jet Transports Differ

Four nations, racing to put passenger jets into service, have come up with four surprisingly different designs

By Ben Kocivar

BY THIS time next year thousands of Americans will be flying in the big new jet transports now being built and tested. Recent discussions with American, British and French manufacturers and airlines by a POPULAR SCIENCE correspondent reveal that the race to be first, always red-hot, is now burning white.

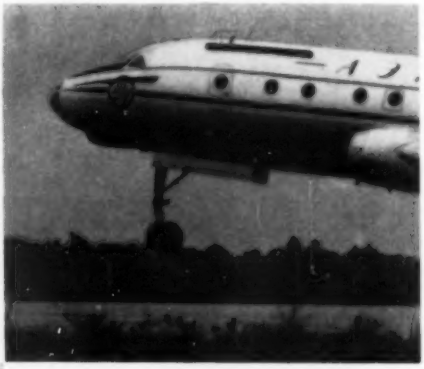
The corporate competition to provide the first jet service is matched by pressures of national prestige and international diplomacy.

All this is not entirely beside the point in a discussion of design. For it is an amazing fact that with four big nations in a race to put big jet transports into service, each country has come up with designs that reflect not only economic needs but national philosophies.

Here briefly are the points to be considered.

1. Britain actually had the first jet transport in service, in 1952. But, pressed to retain its

United States



Russia

Britain

DE HAVILLAND COMET IV is a much-improved version of the ill-fated Comet I, the world's first jet airliner in service, in 1952. Its four Rolls Royce engines are within the wing. Bulges near the wing tips are huge fuel tanks. The plane is primarily a medium-range design, able to operate profitably between airports along British Empire routes.

BOEING 707, first U. S. jet transport in the air, has same basic design philosophy as Douglas DC-8 and smaller Convair 880. All have four pod engines slung below and ahead of low, sharply swept wings. First Boeings may see service this year, Douglas and Convair in 1959.

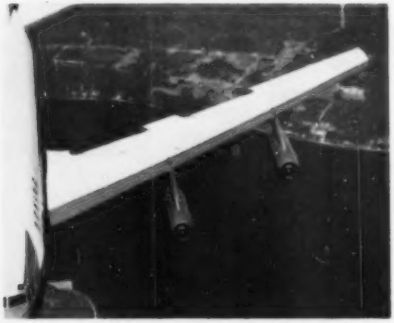
TWIN-ENGINE 500-M.P.H. TU-104, in service in the Soviet empire since 1956, is a medium-range 50-70-passenger transport. Its huge engines gulp so much fuel they would be economically impossible for budget-conscious U. S. airlines. Safety of the Russian jet is an unknown quantity.

France

SUD AVIATION'S CARAVELLE has two Rolls Royce engines mounted near the tail. Designed for ranges to 1,500 miles, it carries 80 passengers at over 475 m.p.h. In a unique proving test, Air France put two on limited but scheduled cargo service on some European runs. It was the first jet quiet enough to be permitted to land in New York.

Size of tail often depends on wing and engine placement

United States



SAFETY from fire, ease of ground servicing are basic reasons why American engines are set well below wings. They are mounted ahead of wings to create smoother airflow.

TAIL SURFACES are relatively big—characteristic of planes whose main wings have considerable sweepback, big flaps. Leading edge of stabilizer is movable for better trim.

France

CARAVELLE'S TWO ENGINES are mounted high and close to the center line of thrust. High mounting reduces chance of sucking up damaging particles from airport runways.

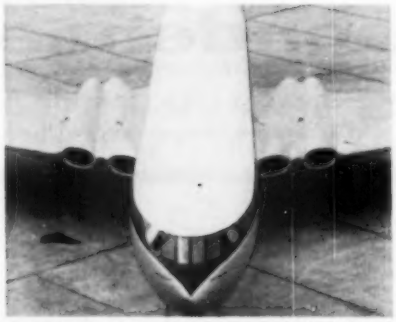
HORIZONTAL TAIL is mounted high, out of the way of jet blast from engines. Caravelle also has huge air brakes which pop up from main wing and can be used at any speeds.

leading position as a world power, it went in too quickly. After two years of service that amazed the world, flaws from hasty design showed up in the disastrous explosion-crashes of the Comet I. These planes were then withdrawn from service. The faults were found. Improvements have been made. New, more powerful engines have been installed. And now the new Comet IV will be ready for service late this year with more flight and testing experience than any other jet transport.

2. Russia's plane has been in service three years and is now operating as a high-speed VIP jet transport to satellite nations in Europe and to the Far East. It is expensive and noisy. But if our commercial airlines can't afford an uneconomical jet transport, a government-owned airline may reason differently. And can you imagine Ivan Ivanovitch trying to keep a TU-104 out of his neighborhood airport because it's disturbing his sleep?

3. The French, independent as ever, even in jet transports, live up to their established flair for coming up with new ideas. The Caravelle, which is generally admitted to be the most advanced transport design, is unique in its mounting of engines at the tail. To back up this philosophy, two American companies, Lockheed and North American, have recently come out with small jet-transport designs

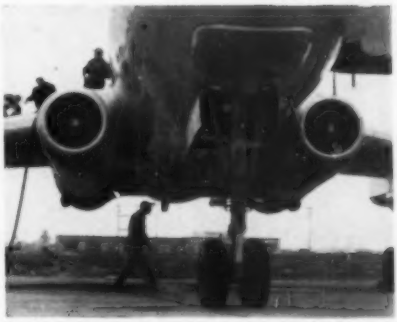
Britain



COMET IV'S FOUR ENGINES are imbedded in its relatively straight wing. This is an old concept, but so well tested by experience that de Havilland considers it worth while.

TAIL SURFACES can be smaller, lighter and create less drag because engines are mounted close to center and will not cause plane to swerve much if an engine should fail.

Russia



TU-104 ENGINES are both mounted close to center line of plane but are not as cleanly placed as Comet's. They are reputedly the most powerful jet engines in the world.

RUDDER AND STABILIZER have marked sweepback, typical of planes with high subsonic speeds. A swept wing meets less air resistance than a straight wing of equal thickness.

that adopt a similar engine placement.

4. The big American designs by Boeing, Douglas and Convair are so similar in design philosophy that the average passenger will have trouble telling them apart unless the planes come equipped with big identification cards. All are low-winged, with four engines slung in pods beneath and ahead of the wings. There will be differences in size and weight, but differences in color will be more noticeable to the casual traveler. American designs have been longer in the making because they have had to face up to some critical demands.

The new planes must be big enough to carry lots of passengers. They must be fast enough to move them notably faster than our present conventional airliners. They must have safety margins as good or better than those of present airliners. They must be quiet enough to be acceptable to noise-conscious private citizens who can scream to their Congressmen. And they must be economical enough to interest the bankers and big investment firms that will put up the money for these $6 million giants.

With this set of requirements, it is little less than amazing that American manufacturers can predict delivery and service so remarkably close to the operating dates of some of the competing nations. END

Plain Facts About Correspondence Schools

By Martin Mann
RESEARCH SUPERVISED BY JOAN STEEN

Part 2: What Can They Do for You?

MAKE More Money Soon . . . Train Now for More Success, Greater Security . . . A Good Job, More Money, Bright Future . . .

Sounds familiar? Those are sample headlines from correspondence-school ads. Alone among educational institutions, the correspondence schools climb out on a limb: They promise you success—in terms of hard cash—if you complete the course. Do they come through? Will you get ahead—win a promotion, find a better job, get a start in business—by studying at home?

This is the central question, the point you want settled when you consider a course for yourself. POPULAR SCIENCE set out to find the answer (last month we gave you an inside look at the operation of correspondence schools).

How was it done? By asking correspondence-school graduates themselves: Did their home study help them or didn't it?

PS undertook a careful statistical study of these "alumni"—research of a type and scale never before attempted. From three of the country's largest private correspondence schools, we obtained the names of 1,800 recent graduates. The names were selected to insure a typical cross-section. We polled them elaborately to pinpoint their circumstances before and after home study.

The results, as will be seen, are an impressive endorsement of education by mail. To a degree, this could have been predicted; a man who is ambitious enough to study in his spare time is also a man you would expect to get ahead. But results outran expectations. In the main, the correspondence graduates reported:

- They got from the courses what they had expected.
- They increased their earnings—by an average of $22.50 a week.
- They won promotions or found new and better jobs.
- They were pleased (even enthusiastic) about the content of courses and the home-study method.

That's a quick rundown of the survey findings. Not everybody fared so well. Some were critical—a few bitterly caustic—about their experiences. The details illuminate a fascinating but poorly understood aspect of American life. And they are important to you, for they can help you make a sound decision when you consider correspondence study for yourself.

Who are the graduates? The men (and the few women) whom PS interviewed turned out to be like people you know. They had attended high school (average formal education was not quite 12 years). Half of them work at skilled trades—carpentry, machine work, repairing, truck driving. The others split up this way: One in five holds a professional or supervisory job, about the same proportion are unskilled laborers, one in 10 is a clerk or salesman.

In age they range from a high-school boy who studied TV as a hobby to an 80-year-old man who started taking correspondence courses 50 years ago and has now completed half a dozen. The average age comes to 36. This is considerably older than the average of those who *enroll* for correspondence courses (28); the successful students—those who

pecially receptive to home-trained men.

Here is the word from the men who know: the results of Popular Science's survey of correspondence-school graduates. It pinpoints what you can—and can't—get from home study

finish their courses—are the mature ones.

One characteristic stands out. These people are do-it-yourselfers in the strict meaning of that phrase. They are extremely self-reliant and take pride in their ability to master difficult tasks by themselves. Many made comments like this:

"In many ways the self-discipline required to complete the assignments and the course has resulted in a greater understanding of the subject matter . . ."

Why they study: The reason most often given was a general one: It would help in the long run. These men look far ahead; they are confident, willing to invest money and effort for future return. But when it comes to the short-range benefits of home study, we found an interesting connection between a man's motives and the kind of course he had taken.

Three-fifths of those covered by the PS survey had taken radio-TV courses. The remaining 40 percent had studied a wide variety of subjects—construction estimating, business management, stationary engineering, surveying, and dozens more. The two groups gave remarkably different reasons for studying, and the results they achieved were also different. So we'll tell you their stories separately.

Students generally (other than TV): When they signed up for correspondence courses, two-thirds were looking for advancement in the work they were already doing; and they studied subjects related to their work. Only one-fourth hoped to break into another line of work; only one-tenth expected to start their own businesses. (The pattern reverses for TV students, as you'll see later.)

Of those pursuing work-related studies, well over 90 percent did stay in their original fields after completing their courses (85 percent stuck with the same employer).

Now how did they make out?

- Promotions: 42 percent *did* advance. Roughly the same proportion gained new or increased supervisory duties.
- Pay: Nine out of 10 got raises. Some boosts were whopping. Even the average increase in pay for all non-TV

How home-study graduates rate themselves . . . and why

I'm much better off	43%
I'm somewhat better off	34%
I'm no better off	11%
It's too soon to tell	12%
I make more money	77%
My work is more satisfying	61%
I have more responsibilities	36%
I have a higher standing in the community	30%
I have more opportunities for advancement	64%

The key question: Would you do it all over again?

The answer: A resounding yes

graduates was a very solid $25 per week.

Whoppingest of all was the Horatio Alger story reported by an oil-field stationary engineer. He studied salesmanship, started selling construction machinery, skyrocketed his earnings from $80 a week to $345! His comment, understandably, was warm:

"I have nothing but praise for correspondence study. It has enabled me to provide a much better living for my family by taking the course and continuing in this field. I constantly refer back to the books and questions and answers that I have."

Now correspondence study alone did not bring all these pay raises. The two-year period covered by the PS study (it takes about that long to complete a correspondence course) saw considerable inflation.

Nevertheless, the increases reported by the correspondence graduates were more than three times higher than the national average ($25 against $8 for all factory production workers). Just looking at average pay, the PS survey makes a powerful case for the correspondence schools.

For some kinds of work, success through correspondence training seems to be almost a sure thing. For instance:

- Electric utilities. The PS survey covered a number of men in this big industry. Without exception, they said that their courses paid off. Every man continued to work for his old company, and every man got a better job with more pay.
- Highway construction. The same story again. Every man advanced—to supervisor, surveyor, engineering aide and so on.
- Foremen (in any industry). Practically every man who took a course in foremanship did become a foreman, if he wasn't one already.

Railroading, textile manufacturing and accounting are other fields that seem especially receptive to home-trained men.

TV graduates. TV repair is the obvious choice for a young man looking for a good field to break into. It has mushroomed from nothing to a $2,000,000,000 business in the last dozen years. No wonder it is so popular among correspondence students.

Only one-eighth of the TV graduates covered by the PS survey were working in the TV business when they began studying. Only one-tenth expected their studies to benefit them in their old jobs.

Instead, the TV group were "switchers," dissatisfied with their old careers, looking for completely different work or at least something new to supplement their old work. Two-thirds hoped to start businesses of their own. But they weren't as certain of the future as the non-TV students. Many of them (half of the total) also indicated that they would look for jobs in the TV field. And the same proportion said they would make personal use of their training: TV repair would be a hobby.

Now, what happened to them?

The 10 percent who were in TV in the beginning and wanted to stay did just that. Two-thirds of this small group reported salary increases—an average of $35 a week. (About 15 percent did not answer this question; only 25 percent reported no change in income.)

Of the larger group who were not in TV but wanted to be, 61 percent made it, one way or another.

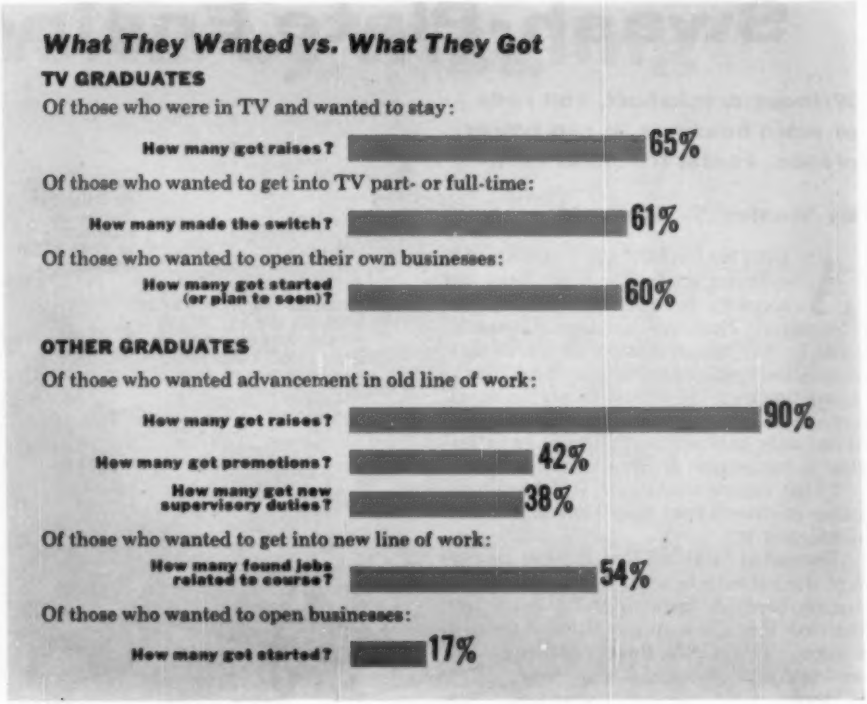
The big dream was "a business of my own"—not necessarily a full-time business, for many of these men held steady jobs that they expected to keep. They were looking for extra income or a cushion for retirement.

Of the group who counted on going into business, the survey found that:

- One-tenth actually started full-time TV repair businesses.
- One-third were operating part-time businesses.
- One-fifth still expected to open businesses (one man complained bitterly that capital promised him had not materialized).

Adding it up: *Two-thirds* of all TV graduates wanted to go into business; *more than half* of them achieved their ambition or were confident they would.

That's the record. For comparison take



the figures on the percentage of college graduates who actually make their major fields of study their lifetime work:

Science—22 percent
Engineering—64 percent
Medicine—96 percent
Education—36 percent

The correspondence schools look pretty good. Their results, like the colleges', are respectable if not spectacular.

How good are the courses? Many of the correspondence graduates added personal comments to their questionnaires. Most were general recommendations, such as these:

"I completed my course and enjoyed it very much; I feel it was worthwhile . . ."

"I found the lessons complete and very well planned . . ."

". . . a practical answer for the married man . . ."

"All I hate is that I didn't take the course 10 or 15 years sooner, for I sure liked it and I sure like radio-TV work . . . I have fixed some pretty tough ones, and I haven't had anyone kick yet about the job I did or the price I charged . . ."

A number of graduates offered praise, but qualified it. For example:

". . . very good if the person really applies serious thinking . . ."

". . . correspondence study will do you the most good if you are doing the kind of work you are studying . . ."

". . . very helpful to persons who are willing to concentrate and to discipline their minds . . ."

Criticisms? Yes, but very few compared with the number of recommendations.

The main criticisms are reflected in these comments:

"The average employer does not realize the value of these courses. That seems to be the attitude of the company I work for."

". . . needs more practical doing and some personal instruction. It's hard for me to learn from just reading a book and looking at pictures. When someone shows me, then I can do it."

[*Continued on page 234*]

Swash-Plate Engine

Without crankshaft, con rods or main bearings, it can power planes, boats, trucks or cars

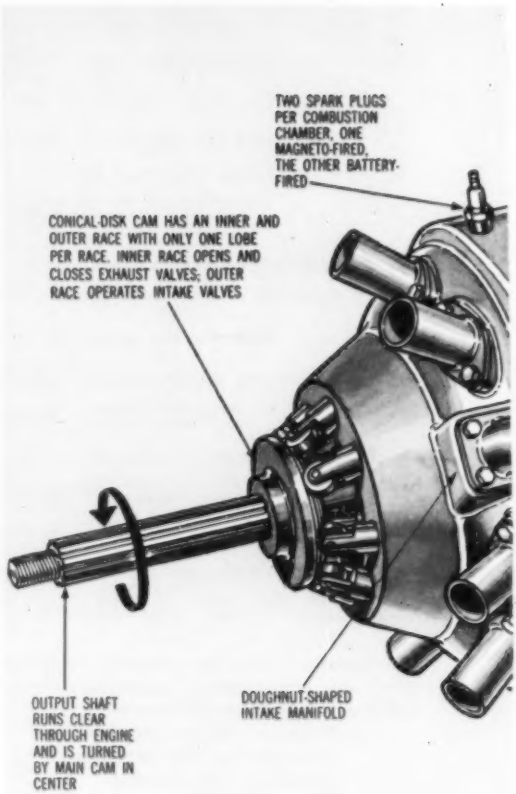
By Wesley S. Griswold

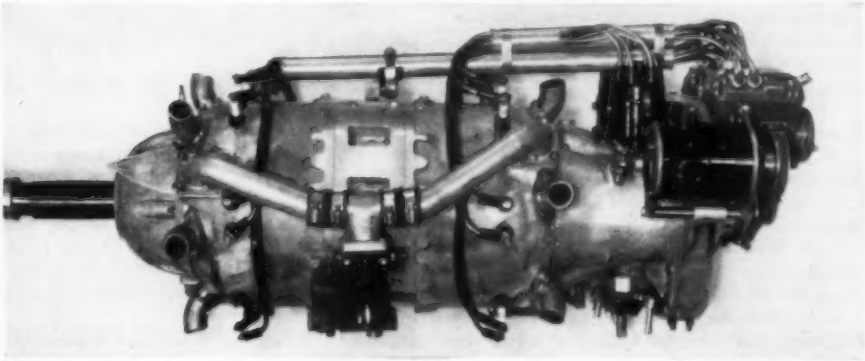
AN EXTRAORDINARY 200-hp., 12-cylinder engine for lightplanes has recently been introduced by the Herrmann Engineering Co., Glendale, Cal. It has no conventional crankshaft, connecting rods or main bearings. It gets along fine without push rods, rocker arms, crankcase and vibration dampers. In fact, it has only half as many parts as an orthodox piston engine of comparable power.

"This engine won't run. It'll burn up," other engineers told Karl Herrmann, who developed it.

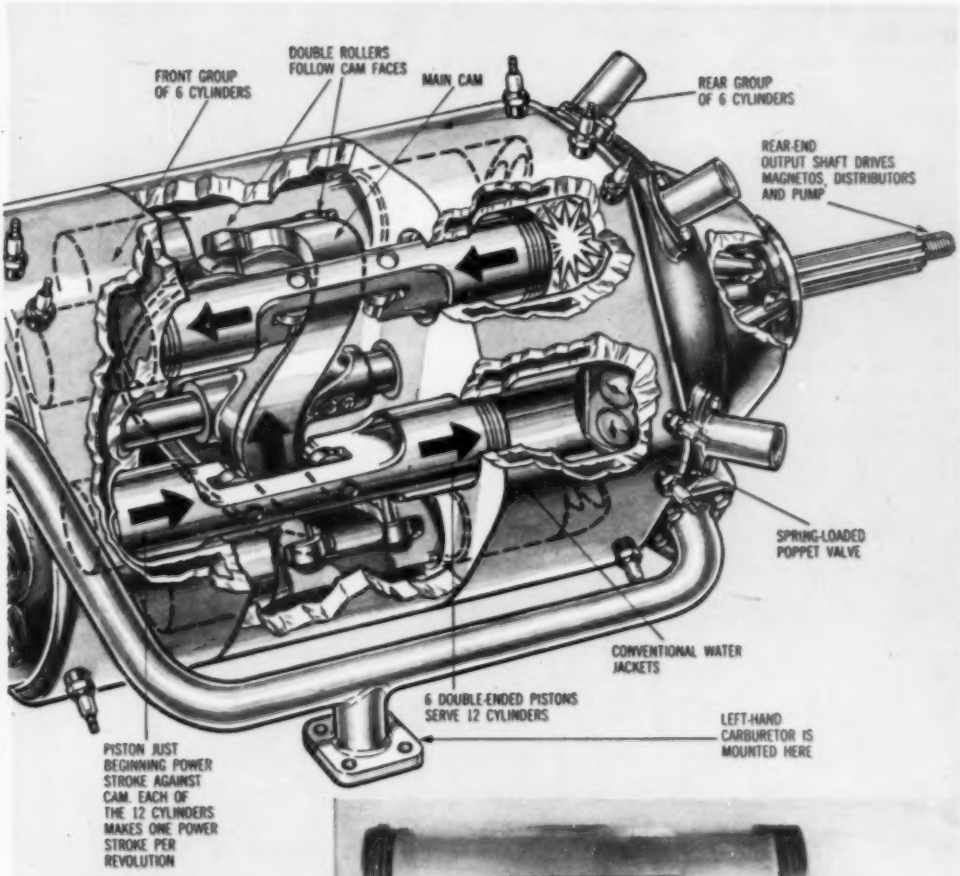
Instead of fulfilling that gloomy prophecy, the valve-in-head, liquid-cooled X375 engine breezed through a 150-hour test run for the Civil Aeronautics Administration. The CAA then certified it as airworthy.

Here's how the engine works: Its main shaft is straight, with a large cam mounted at the center of it. Six double-ended pistons are clustered around the cam, or "swash plate," which engages the center of each of them. Pairs of trunnion rollers in the pistons clasp the edge of the cam and take the place of wrist pins and connecting rods. Two disk cams on the main shaft operate the valves. Four bronze bushings pressed into the drum-shaped

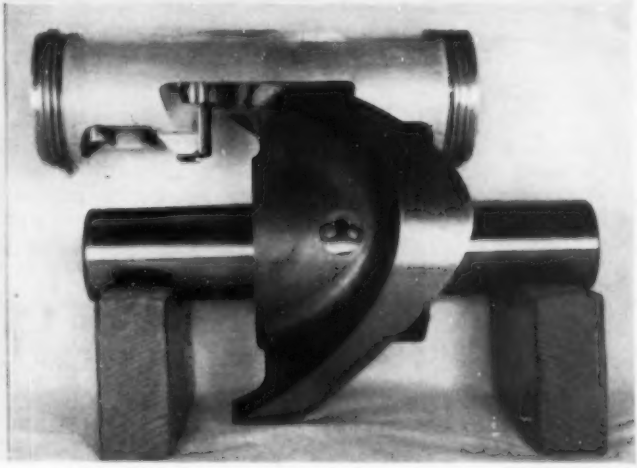




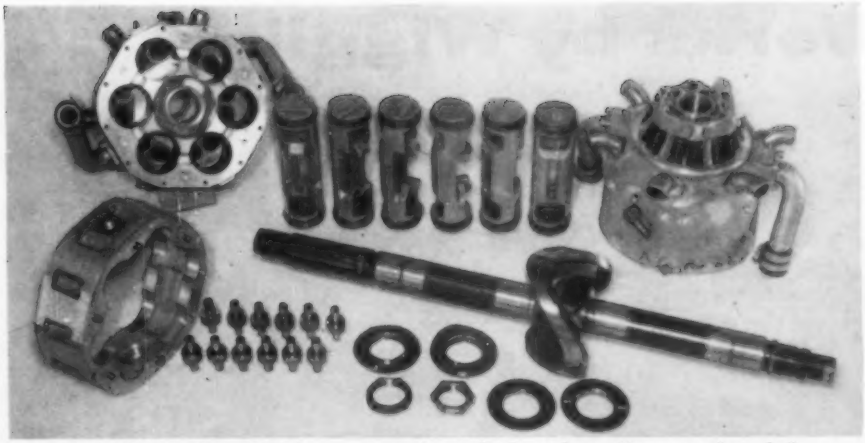
Works by Wiggling



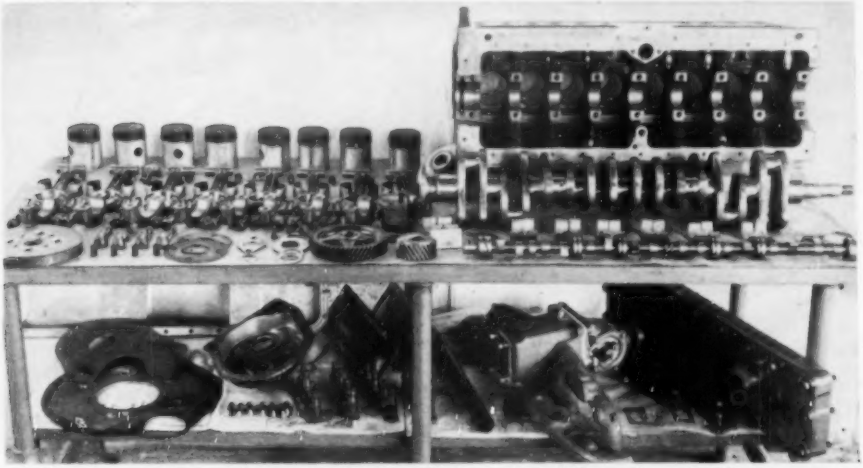
OPERATION OF ENGINE is shown in cutaway above. Its heart is a big cam on a straight shaft (in exhibit form at right). Compactness is evident in picture at left. Engine is 50½ inches long, 18 high. Its dry weight, with dual ignition, starter and generator, is 377 pounds, or 1.8 pounds per horsepower compared with two for an auto engine.



Picture News



Just about all there is to the Herrmann engine is laid out here. Now see photo below . . .



. . . for a comparison with a typical eight-cylinder automobile engine of 140 horsepower.

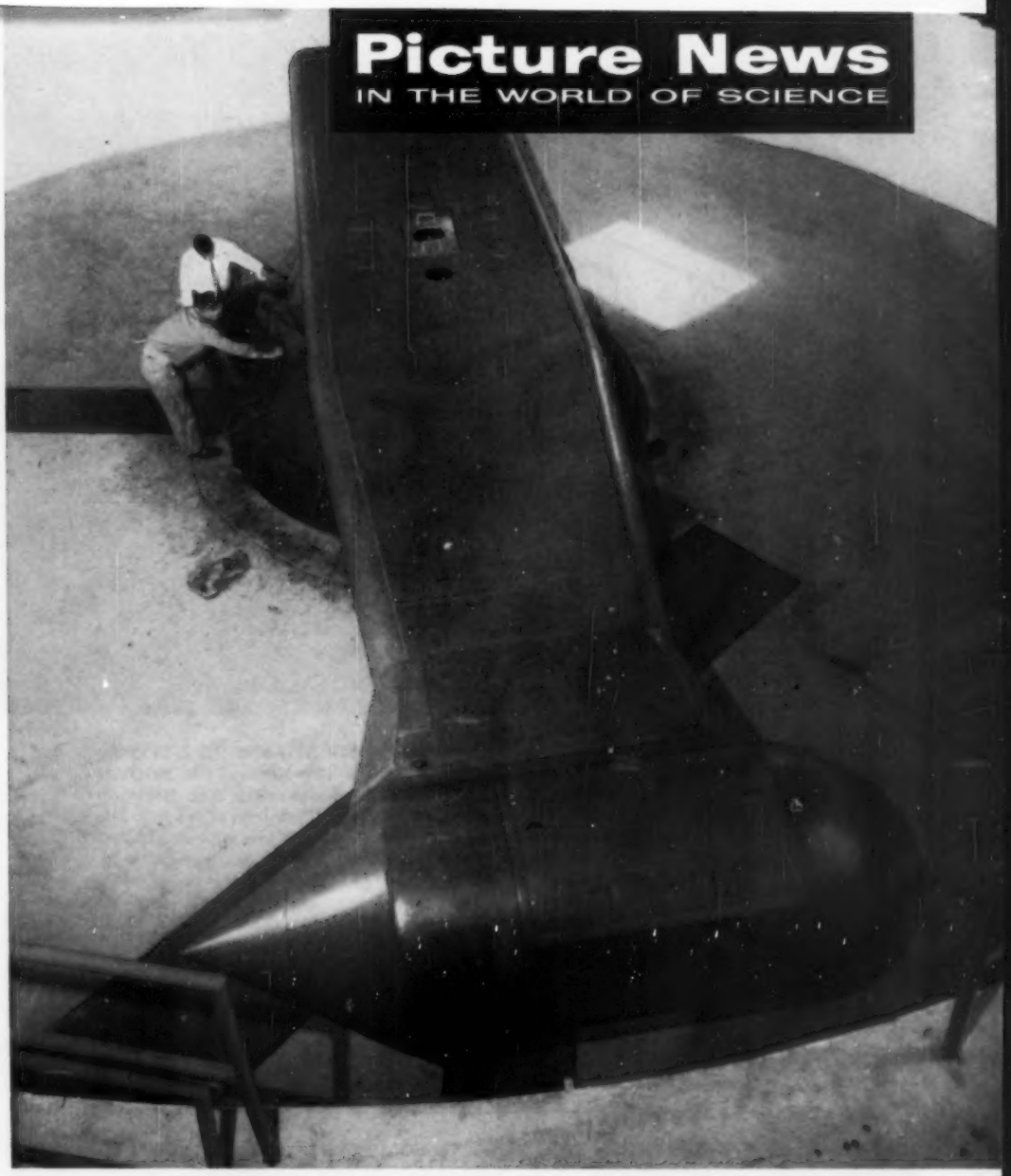
cylinder block serve as the main bearings.

The swash-plate principle is described in engineering literature as far back as 1841, and has been used for many things, including aiming guns on warships. The swash-plate compressor (in which, of course, the plate moves the pistons, not the pistons the plate) is a commonplace in auto air conditioning. Many experimental internal-combustion swash-plate engines have been built since the turn of the century (PS, Feb. '48), and the idea was used in steam engines even before then.

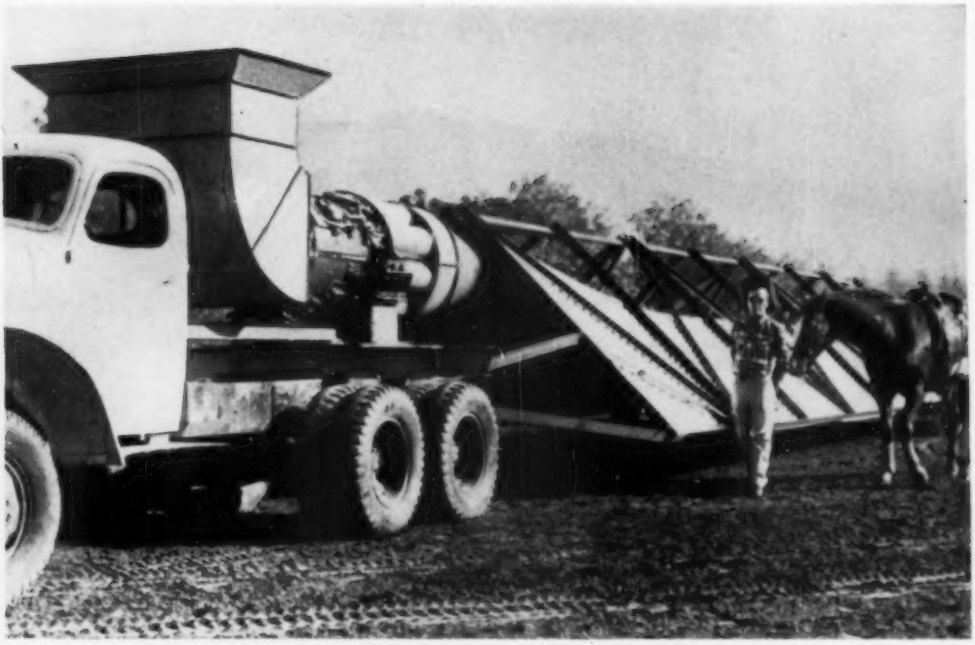
The secret of the Herrmann engine's unexpected efficiency lies in the shape of the big cam, which is so formed that the six double pistons produce 12 power strokes each time the shaft revolves. The engine's torque is thus made practically uniform, and vibration is greatly reduced. Engine wear is sharply lessened, too.

The X375 engine has a compression ratio of 8:1 and displacement of 373 cu. in. Herrmann points out also that the engine can be easily adapted for use in cars, trucks, boats, air compressors, generators and pumps. END

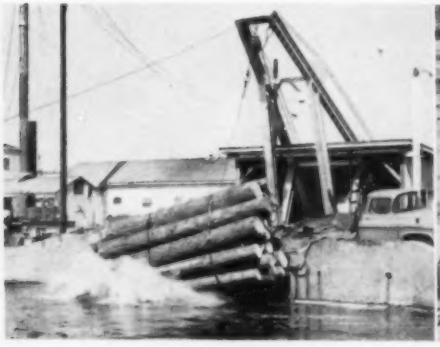
Picture News
IN THE WORLD OF SCIENCE

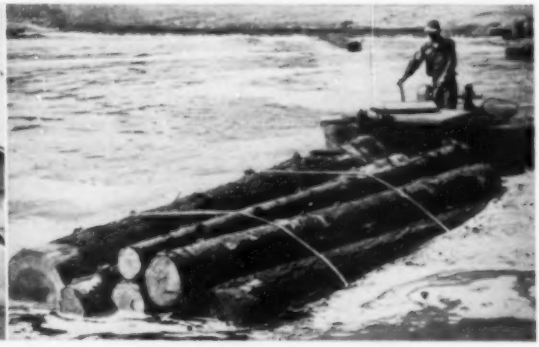


Huge centrifuge whirls ICBM parts. Designed to test parts of the Atlas intercontinental ballistic missile subjected to 100 times the force of gravity, this 40-foot centrifuge has been installed in the Convair-Astronautics plant at San Diego, Cal. Objects undergoing tests of extreme temperatures and acceleration are placed—up to a ton at a time—in the compartment in the foreground and spun at 121 r.p.m. at the end of the 20-foot boom. Shaker mechanism will also test for vibration.

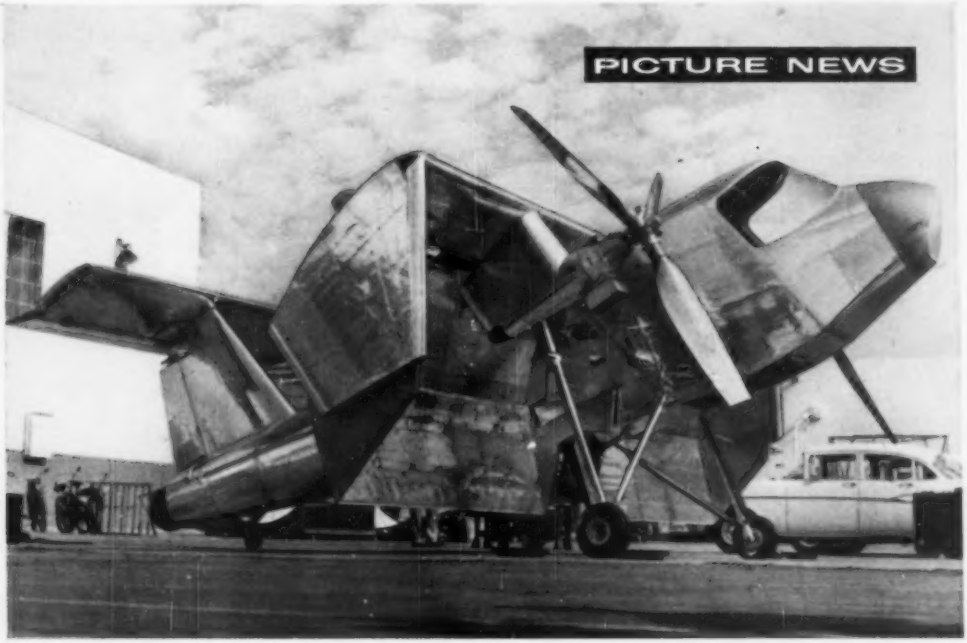


Jet blast dries race track. Officials of Santa Anita race track at Arcadia, Cal., are making things tough for mudders with this big machine that shoots out a blast of hot air to dry off rain and soft spots on a wet track. It works like a jet engine in a plane. Air scooped into the vertical intake behind the driver's seat is heated by the turbine, blown 15 feet in a jet stream, and deflected by the canopy to the track.



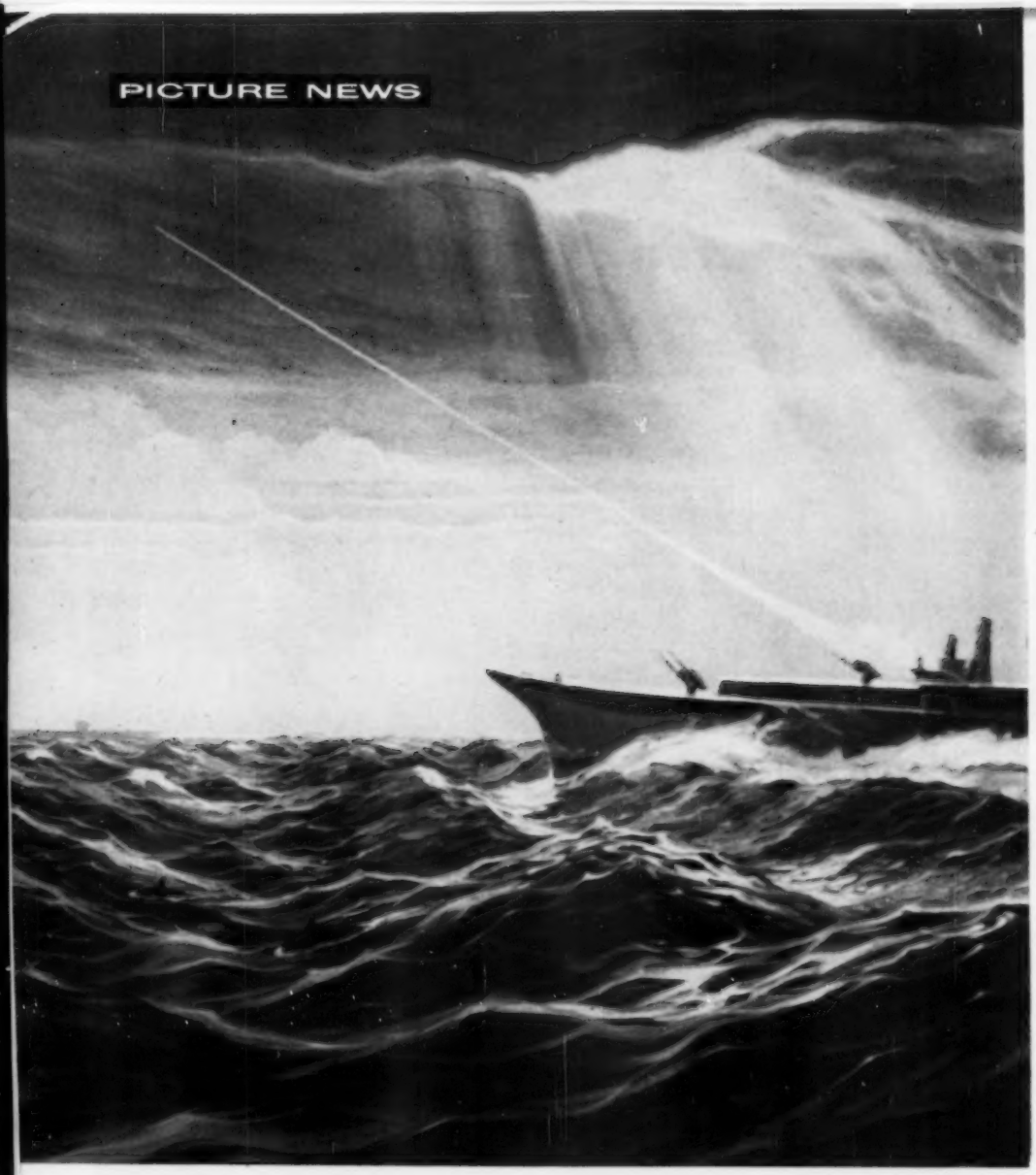


Bundling prevents log jams. Instead of dumping logs helter-skelter into a log pond, lumberjacks bound these into neat bundles that can be pushed by motorboats easily and quickly to the lumber mill. When a truckload of logs arrives at the Elk Lumber Co. in Oregon, it is bound by steel bands and dumped into the water by a power lift. Boats then take over. No log jams, no sinkers—and the pond holds more.

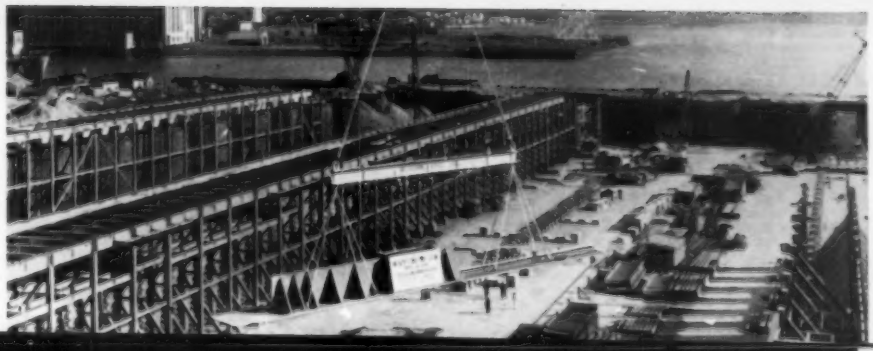


Army plane takes off straight up. This unique experimental airplane can take off and land vertically, hover, and fly forward. Designed and built by Ryan for the Army, the X-13 Vertiplane is nose-high on the ground, but its pilot sits horizontally in both vertical and horizontal flight. Double retractable wing flaps, which extend far below the wings, bend the propeller slipstream downward for takeoff, hovering and landing.

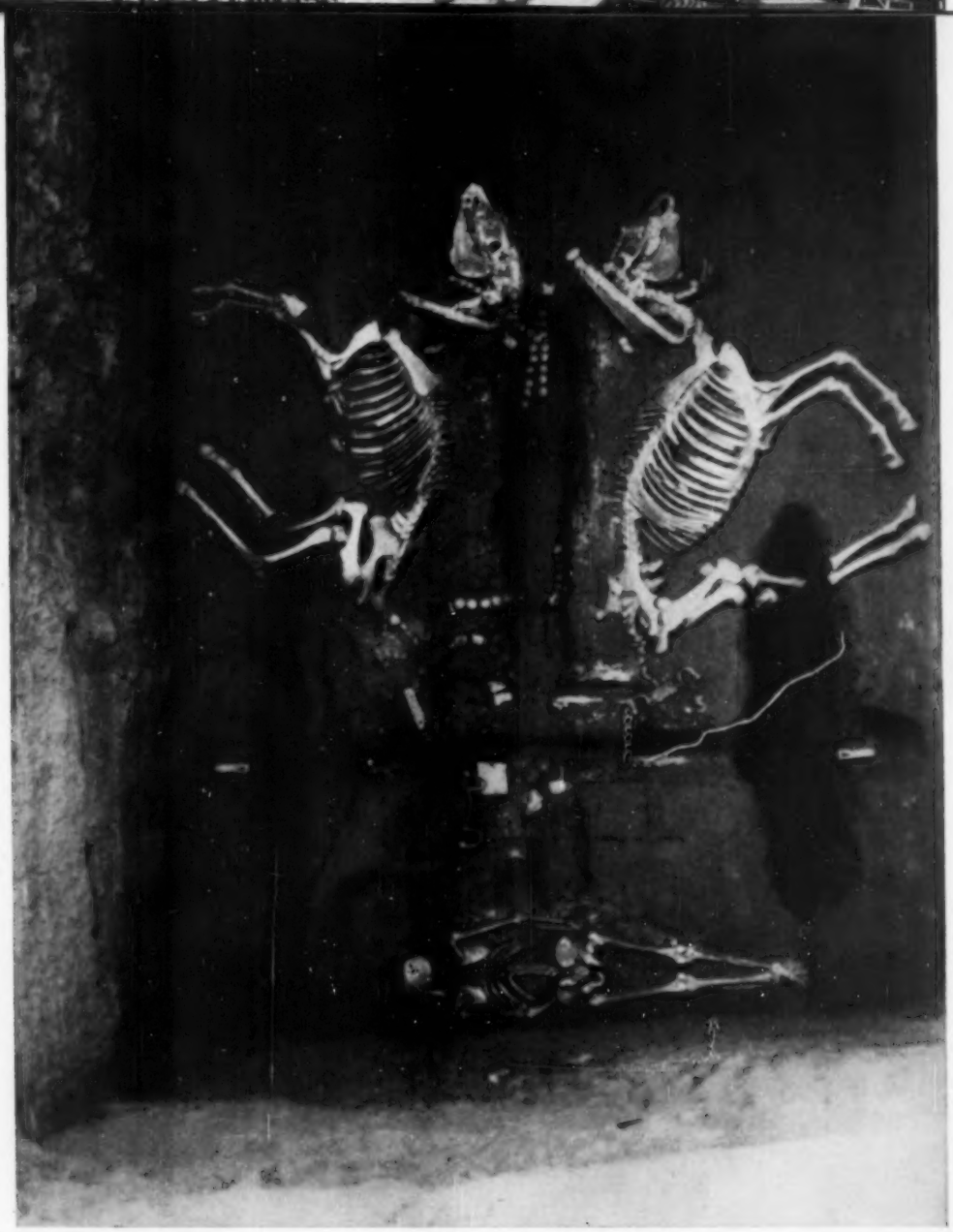
Truck folds up for plane lift. Here's a collapsible four-man truck that folds into a block a tenth the size of the normal quarter-tonner for easy airlifting. With the seats dropped and the jointed steering column swung down, the two boxlike body members are raised and clamped for quick storage. Suspension units are then disconnected and the wheels folded. Setting up is a one-minute job. It's a British army product.



First nuclear cruiser. With the laying of the keel (lower right) at Bethlehem Steel's Quincy, Mass., yard, construction began on the world's first atomic cruiser. The USS Long Beach, shown above in a dramatic painting by Lieut. Comdr. Edward M. Stevenson, will be the Navy's first nuclear-powered surface ship when ready in 1961. The $100,000,000 warship will be 700 feet long, displace 14,000 tons, have no smokestacks, no main gun batteries. She will be armed with guided missiles and studded with radar. Westinghouse is building the reactor.



Ultra-modern church. Typical of the new architecture replacing bombed-out buildings in Germany is this church in a striking design of tomorrow. It's the Dreifaltigkeitskirche, or Holy Trinity Church, just completed in Hamburg. Among outstanding features are a detached, open "A" steeple, an oval nave rising in the center like the prow of a ship, and a facade resembling a modern open-air auditorium.



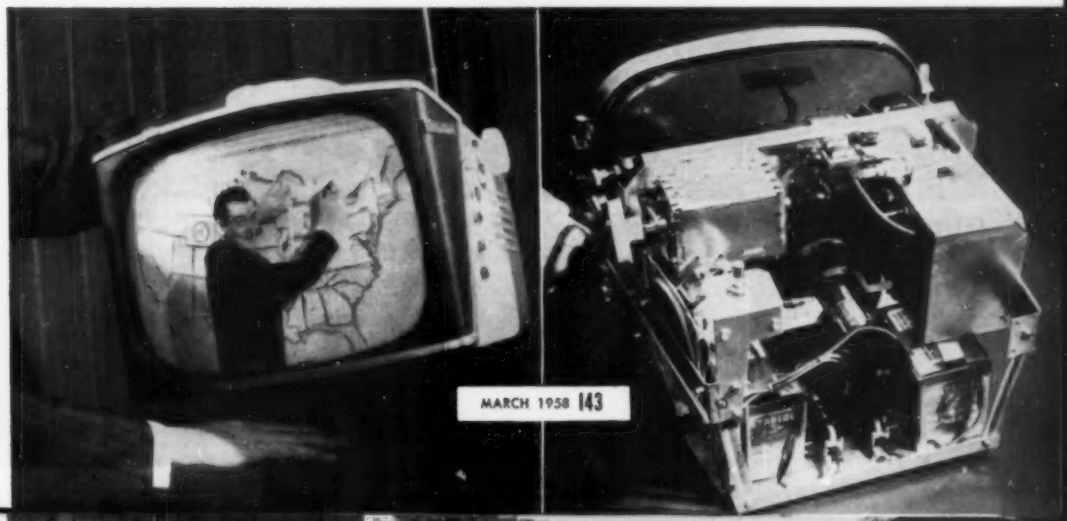
Ancient chariot team. These bones of a charioteer, his horses, and bronze remains of his chariot were excavated recently in China. They were buried 3,000 years ago near Anyang, in Honan, during the Shang dynasty. Shown besides the skeletons in this Britain-China Association photo are pits in which the wheels, axle and shaft rested, yokes around the horses' necks, axle caps, ornaments. The chariot has disintegrated.

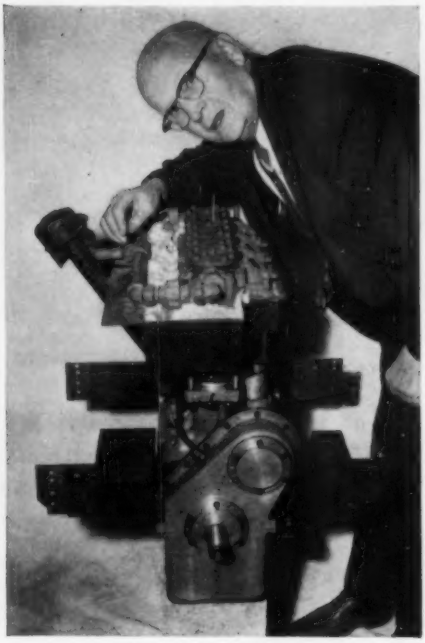
Magnet will trap cosmic rays. This four-ton coil for a new 100-ton "cloud chamber" is wound of 3,560 feet of linen-wrapped copper. It is one of nine that will form a powerful magnet in a device for applying up to a billion billion electron volts from cosmic rays in a new study at Indiana University probing the secrets of the atom. Cosmic rays enter saturated atmosphere in the chamber to smash atom nuclei, leaving vapor trails which will be photographed with fast stereoscopic cameras.

Motel made of buses. To keep costs down, and rates low, A. A. Arnold built the motel below of discarded buses. He bought them at $20 a bus in a junk yard and then went to work. Each has living and sleeping quarters, a kitchen with gas stove, refrigerator and sink, and an outside shower. The motel is on U. S. 1, 30 miles south of Jacksonville, Fla.

Supersonic photography. The pilot of a single-seat interceptor fast enough to keep pace with the supersonic B-58 Hustler already has his hands full, so Convair engineers mounted this regulation gun camera on his helmet. Now, flying chase with the faster-than-sound bomber, he can take movies of anything he sees through the view finder in front of his eyes. To lighten camera weight, engineers discarded all unnecessary parts, drilled holes in the base. Film reloading is automatic.

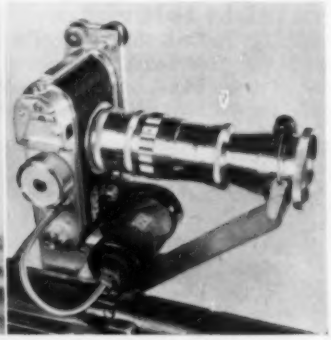
Portable television. Run by rechargeable batteries, this TV set is the first that is really portable independent of plug-in house current. It employs transistors, instead of tubes, to keep the size down, gives a 14-inch picture and operates on two batteries that give six hours of viewing on one charge. Motorola expects to market it sometime in 1960.



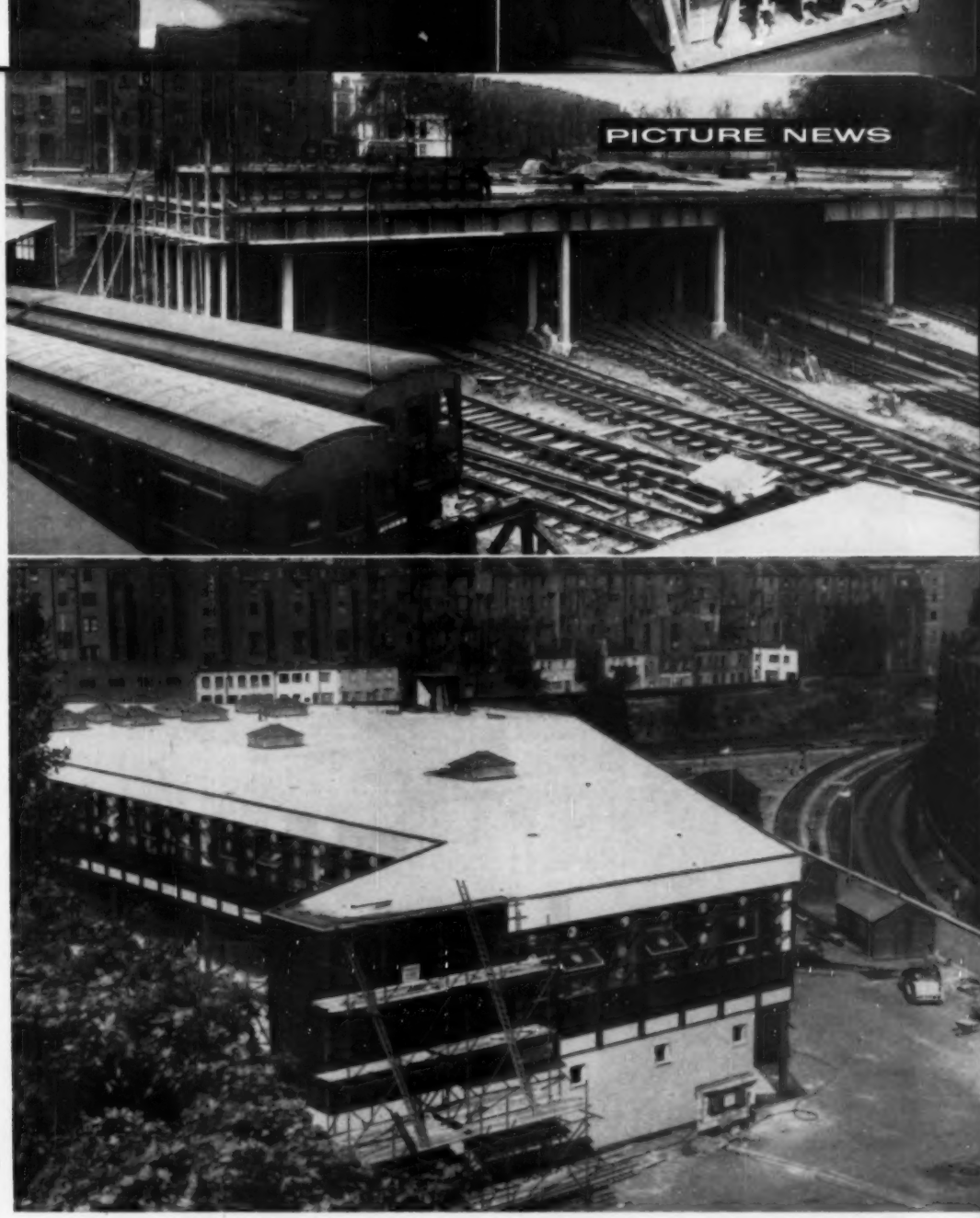


Steam-car engine. Built by Calvin C. Williams of Hatfield, Pa., this engine gets 40 miles per gallon on 16-cent fuel in a 1950 Ford. Its four in-line cylinders can take steam at 1,000 pounds pressure, superheated to 1,500 degrees.

Zippered bridge. Like a big zipper, a cast-steel expansion joint on new Swift Creek bridge at Cougar, Wash., opens and closes with the weather to prevent cracking of the concrete floor. Here the opening indicates a temperature of 38 degrees.



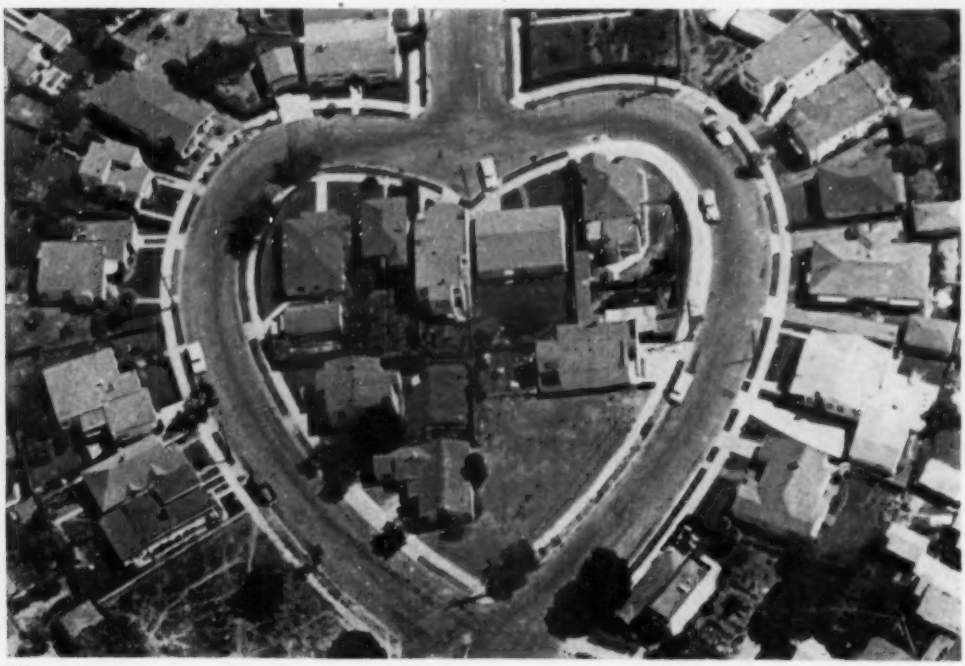
Gun cameras 'shoot down' planes. These cameras (movie at left, still at right) were mounted on rifles to determine vulnerability of low-flying ground-support planes and helicopters. They are used at the Army Combat Development Experimentation Center at Fort Ord, Cal., to record effectiveness of enemy fire on support aircraft. Photos taken each time the trigger is squeezed are studied for interpretation of firepower. The GI in the photo is firing a submachine gun.

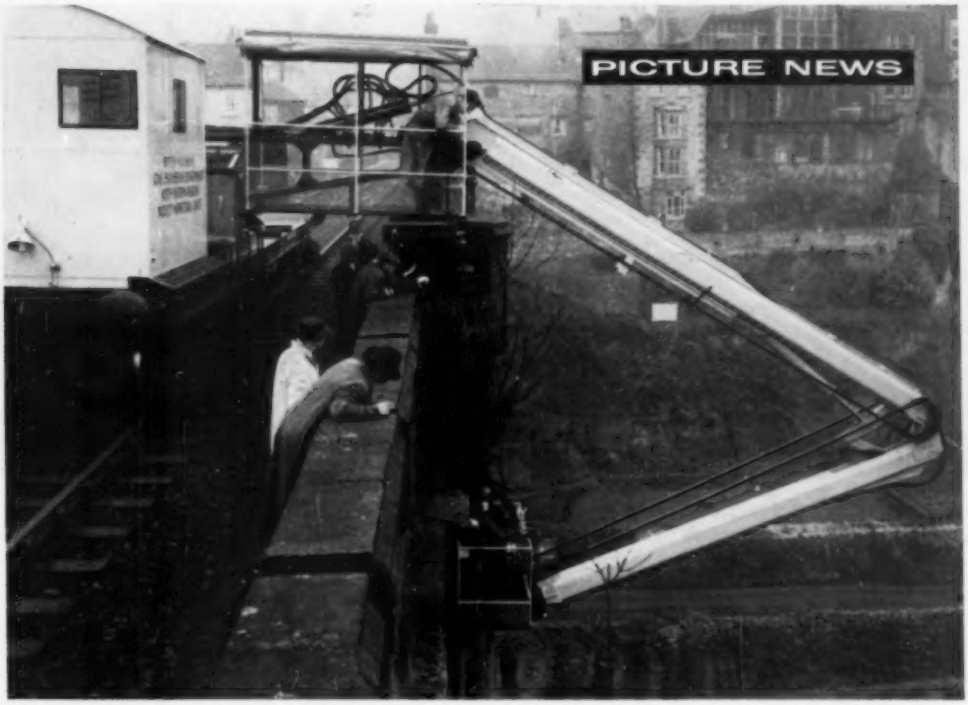


Prefabricated air terminal. When the lease ran out on the city air terminal at Waterloo station in London, this building had to be erected in a hurry. The $700,000 structure was put up in 108 days on a two-acre steel raft over railroad tracks in Kensington. Most of the parts for floors, walls and roof were ordered before the site was bought. They were delivered and stored nearby as the platform went up, then assembled on a rigid time schedule. Interior fittings came last.

Cross-country cruiser. The wraparound window at the rear of this luxury bus encloses a passenger lounge and lavatory. Built for Greyhound by Mack Trucks, the streamliner also includes such innovations as high-level seats on one floor with a folding table at each. It holds 39.

Valentine terrace. An ideal spot for honeymooners, this heart-shaped street is the center of a new housing development at San Bruno, Cal. It is called simply Carlton Terrace by the builders, but it leads into a main artery at top that goes under the appropriate name of Cupid Row.





'Bender' looks under bridge. This queer-looking machine can lower an inspection or repair crew 29 feet down the sides of a bridge or 15 feet under the arch. It's a British invention for maintenance of high railroad bridges. The cab at the end of the two hinged arms is equipped with a phone, floodlights and electric outlets for power tools.

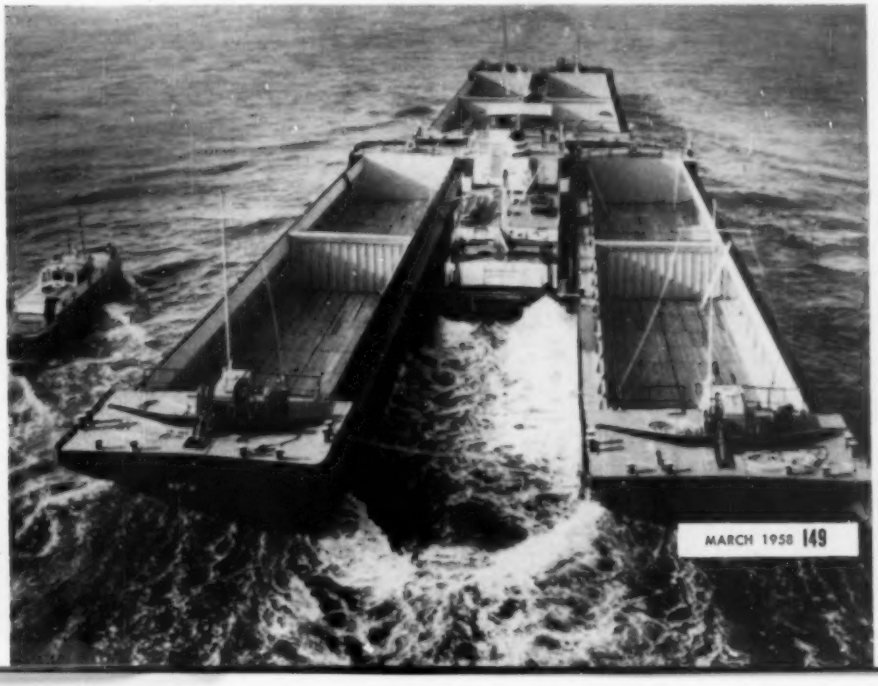
Tandem tractors multiply power. Hitching these two tractors together, Ford engineers obtained half again as much pulling power as that of the two used separately. They removed the front wheels of both and joined them with a pivot-point link. Steering is from the seat of the rear machine, with hydraulic cylinders swiveling the entire front.

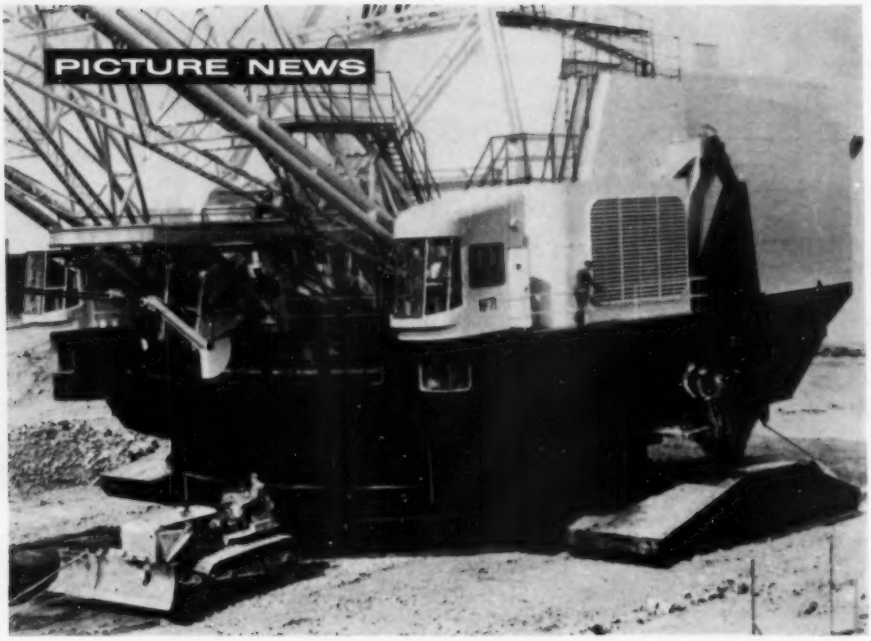
Super drydock builds supercarrier. The nation's largest private drydock, completed in 13 months by special underwater techniques for New York Shipbuilding Corp. at Camden, N.J., this year spawns its first ship. She's the missile-armed supercarrier Kitty Hawk, shown under construction in the photo at right. The first step after dredging for the huge box was to enclose the area with a 55-foot-thick wall

Radar goes on TV. Latest in air-traffic control, the markers on the board below are picked up by a ceiling-mounted television camera and shown, along with radar information, on a new French two-gun cathode-ray tube at left. Distributed by Intercontinental Electronics and tested by CAA, it puts a picture from one control center on several TV screens.

formed, as at left by cells filled with concrete. Traprock was then dumped on the bottom to a depth of 25 feet, dragged level and pierced by pipes through which a 300,000-ton slab was poured—the biggest underwater concreting job on record. The finished basin, weighing a million tons, "floats" on underground water like a bogged ship. A fifth of a mile long, it holds 54 million gallons of water, is emptied by pumps.

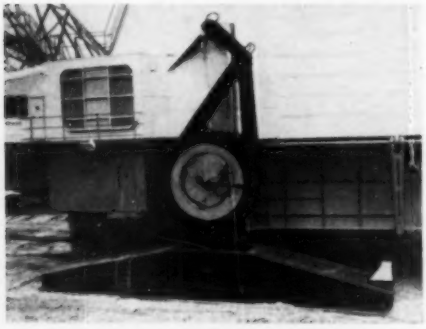
Four-barge towboat. This new tugboat, built by a Mainz yard for work on the Rhine in Germany and Holland, tows four boats. Called the *Wasserbueffel* (water buffalo), it is equipped with two diesel motors totaling 1,260 hp., pushes two 1,300-ton barges and tows two others at its sides. It is shown here starting a trial run to Rotterdam.

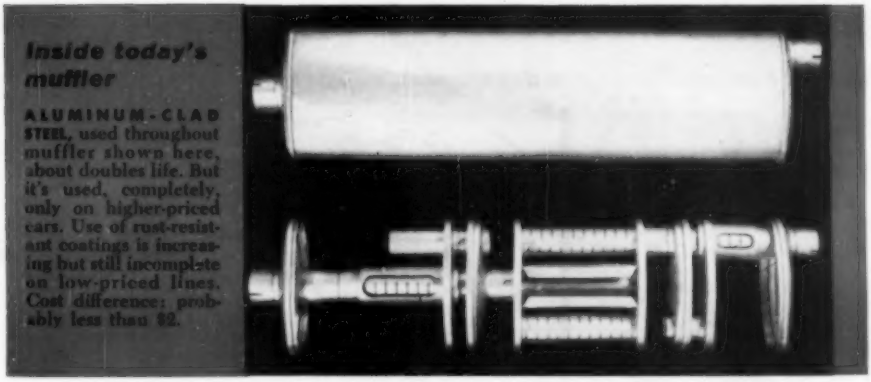




Walking dragline. This huge dredge moves during digging operations by taking seven-foot strides with two feet, each 9½ feet wide by 48 feet long. With one foot planted on the ground, its eccentric-driven leg lifts the entire machine and slides it to a new position in any direction. The opposite leg takes the next step.

Built by Ransomes & Rapier, British engineering-equipment firm, it was transported piecemeal to an ironstone-mining site at Exton Park and reassembled. At left is a view of the full stretch of its 300-foot jib, while a close-up of the eccentric leg of a similar dragline is shown below.





Inside today's muffler

ALUMINUM-CLAD STEEL, used throughout muffler shown here, about doubles life. But it's used, completely, only on higher-priced cars. Use of rust-resistant coatings is increasing but still incomplete on low-priced lines. Cost difference: probably less than $2.

Detroit tackles the trouble with

Car Mufflers

At last they're catching up with the tougher demands made by the new engines and fuels

By Hubert Luckett

LOST in the fanfare for fins and formidable horsepower in '58 is the news that Detroit finally has recognized: (1) that all cars are harder on mufflers and tailpipes these days; (2) that corrosion protection for the exhaust system is not just a frill for the higher-priced cars.

The use of zinc- and aluminum-coated steel for greater rust resistance in exhaust systems is not new. What *is* new is the change in Detroit's penny-pinching attitude toward the use of it on lower-priced cars. This is a tacit admission of the truth of the widespread complaint that mufflers don't last as long as they used to.

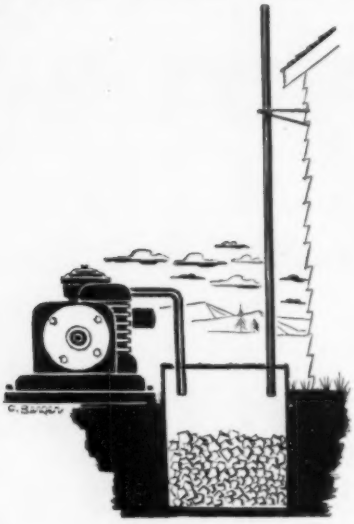
More effort, too, is being put into improving the muffler's primary function—silencing the exhaust. Wrapped mufflers, for example, are one reason for the velvety quiet of an expensive car's exhaust. The wrapping: a layer of asbestos covered by a layer of steel. A simple little dodge like this had long been considered too luxurious to lavish on a mere $2,000 car. But, in '58, even the most widely sold cars have a wrapped muffler—although the asbestos layer is skipped on most of the lowest-priced models.

This manufacturing economy is why you probably used up one or more mufflers and/or tailpipes on your late-model car before you wore out your first set of tires. It represents the kind of economics that the customer who is laying out upwards of $80 in monthly payments on his two-year-old car will find hard to appreciate. But, in the cost-accounting world of the big car manufacturer, it is as logical as spreading butter on bread: Save a buck on a muffler that doesn't impress the customer or help sell the car. Use it instead to add another chrome strip that may catch his fancy and get his name on the dotted line.

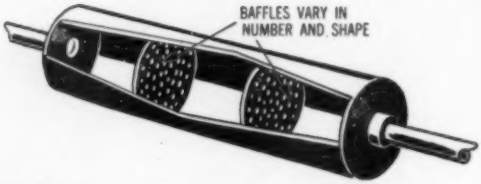
If stylists could get the muffler out from under the car and design it to outshine the tail fins, you'd get a stainless-steel exhaust system that would last the life of the car.

Why do mufflers rust faster now? A frequent claim by car dealers is that the increased use of salt on roads during the winter is to blame. But this doesn't stand up to the facts. Nor does the claim that salt air near the coast causes early muffler failure. The records of Midas, Inc., who operate 200 muffler-replace-

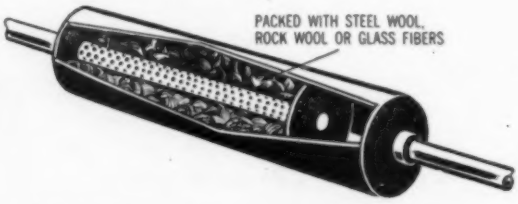
Here's how mufflers have developed



EARLY engines used in rural home electric plants came without mufflers. Buyers were told to bury a barrel and connect it up as shown. Silencing was very effective.



1900's Baffle type was the basic design of most mufflers up to the early '30's. Essentially they depended on "straining" the sound through many small holes. Silencing was poor and the back pressure was high.



1920's Packed mufflers were used in the late '20's and the early '30's. They are still sold in the accessory market for that "deep-toned" sound. Back pressure is low; silencing poor on low frequencies; life short.

ment shops from coast to coast, yield no evidence to back up these common beliefs. The main cause of muffler failure, exhaust-system engineers say, is corrosion from the *inside*.

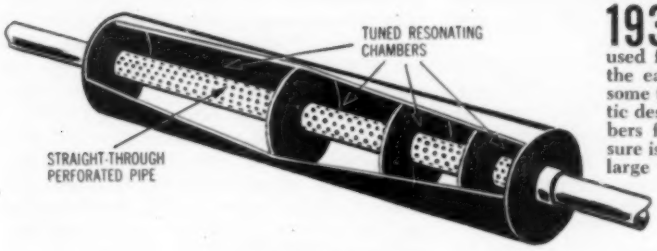
Doesn't seem logical, you say? The outside is exposed to the elements—it gets splashed with water, caked with mud, crusted with salt and whipped by wind, sand and gravel. The inside is almost completely enclosed, protected from this wear and tear.

Yes. But . . .

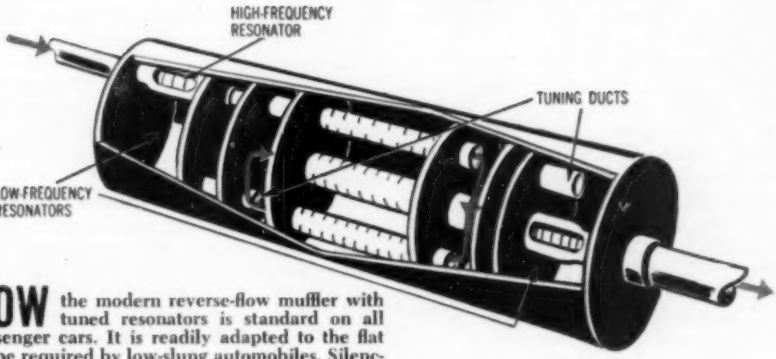
Your car's engine is also a chemical factory. It manufactures a whole string of highly corrosive chemicals: acetones, aldehydes, ketones, formic acid, acetic acid, sulfuric acid, hydrochloric acid, hydrobromic acid, and a host of others. Along with these, it makes over a gallon of water for every gallon of gasoline you burn. And all these by-products must go through the exhaust system. Worse yet: Under certain operating conditions, they tarry long enough in the muffler and tailpipe to exercise their full corrosive power on the steel.

How has the situation changed for the worse in the past few years? The answer is a double-horned dilemma involving your driving habits and the new high-performance engines.

When you crank up a high-powered engine on a cold morning and drive a mile or two to the station or drug store, it scarcely reaches operating temperature before you shut it off. Chances are that the automatic choke will still be partly closed and the muffler will just be reaching the temperature at which maximum corrosion takes place. Result: The inside of the muffler will be coated with a film of "water" (more accurately, a solution of all the corrosive chemicals mentioned



1930's The straight-through muffler, used from the early '30's into the early '50's, is still put on some trucks. It initiated acoustic design with resonant chambers for silencing. Back pressure is low, silencing good, but large volume is required.



NOW the modern reverse-flow muffler with tuned resonators is standard on all passenger cars. It is readily adapted to the flat shape required by low-slung automobiles. Silencing is excellent for both low and high frequencies; the back pressure is desirably low; large volumes (a space problem) are not required.

above) like the outside of a glass of ice water on a humid summer day. It doesn't take long for a teacup or more of this steel-eating brew to collect in a puddle in the bottom of the muffler. You are operating a legal distillery whose product will insure continued economic security for the muffler-replacement boys.

You have asked for, and gotten, an automobile that will do 0 to 60 m.p.h. in 10 seconds and run all day at 80 m.p.h.—but you are driving more in short hops and in stop-and-go traffic. One way you pay for having all these horses at your command is in more frequent muffler-tailpipe replacement.

Recent research at Arvin Industries, the largest suppliers of mufflers as original equipment to all Detroit car makers, has shown that most muffler corrosion occurs in a fairly narrow temperature range. The danger zone is from 170 to 190 degrees F.—with a sharp peak in corrosion rate at 180 degrees. To relate this information to driving habits, in-use tests were made with a typical late-model V-8. Here's what the tests revealed:

The temperature of maximum corrosion is reached in: seven minutes at 20 m.p.h.; four minutes at 30 m.p.h.; three minutes at 40 m.p.h.

At 20 m.p.h. the muffler is *still at the temperature of maximum corrosion* at the end of 20 minutes. Even at 40 miles an hour it takes 10 minutes to get beyond the range. With typical stop-and-go driving, you *never* get outside this range of maximum corrosion.

There is a man who works for Arvin whose love for rural living furnished practical proof of these facts. Around the shop he had the reputation of being the best customer for free mufflers. Regularly, every five or six months, he came

around for a fresh replacement. He lived *two* miles from work and drove his car in every day. Then he moved to a new home *12* miles from the plant. He has not needed a new muffler since.

So part of the problem is big-displacement engines that use more fuel in stop-and-start driving. More fuel burned means larger quantities of corrosive by-products. Muffler and tailpipe warm-up is slower, too. The longer they stay cold, the more condensate they extract from the exhaust gases.

Dual exhausts aggravate an already bad situation. Duals run cooler than single systems. Particularly the cold side (the one shut off by the heat-riser valve during warm-up) uses up mufflers and tailpipes much quicker than a single-exhaust system under the same driving conditions. This effect is so pronounced that manufacturers now try to equalize the useful life of the two by using more corrosion protection in the cold muffler.

Higher-performance engines create, indirectly, still another problem. With higher compression ratios, the new engines' octane appetite has gone up. To satisfy this need for higher-octane gas, the oil companies have had to add more and more lead compound to the gasoline. The lead itself does not do the dirty work; the villain is a necessary part of the compound, ethylene di-bromide. This changes to highly corrosive hydrobromic acid in the exhaust.

Research indicates that recent increases in the quantity of this acid in the exhaust bear a major responsibility for the higher corrosion rate.

The challenge of longer muffler life seems particularly to excite the inventive genius of would-be Edisons. Chrysler engineers report that these are second in number only to carburetor inventors. Most of the ideas involve ingenious ways of removing the collected condensate or using the air rushing past when the car is moving to ventilate or accelerate the passage of gases through the muffler.

Drainholes in the bottom? They seem to be the obvious answer that occurs to everyone with even a superficial knowledge of the problem. But experience shows that mufflers with external drainholes usually rust out quicker. There's a danger aside from this rather devastating objection: According to a Ford engineer, holes not only will whistle at today's high muffler pressures but they leak deadly carbon monoxide gas where it might get into the passenger compartment. A tricky way around the latter objections was actually tried on production cars by an independent manufacturer a few years back. An aspirator actuated by the flow of exhaust gases was used to suck the condensate from the bottom of the muffler and spray it out the tailpipe. All these drainage schemes fail because the pool of collected condensate is not the real culprit. According to findings at Arvin, the significant corrosive action takes place when the condensate coats the metal surface in a film like the "sweat" on a highball glass. To bear this out, even a casual check of rusted mufflers will show that they frequently fail at the top where there is no pool of condensate.

The only practical answer to longer muffler life that the people who make them have come up with at present is to use materials that can better resist the chemical attack of the combustion products. These materials include ceramics, stainless steel, high-temperature paints, zinc and aluminum coatings. Practical tests have shown that zinc- and/or aluminum-coated steels are the best economical preventive. If used generously enough, they can give reasonable assurance that the muffler and tailpipe will at least survive the first ownership of two or three years. Stainless steel is the ultimate material. Its advocates claim it would last the life of the car. But it would add—at various estimates—$15 to $25 to the car's cost.

You might think $25 a small price to tack on to a $2,000 to $4,000 investment, but apparently the customers didn't think so a few years ago when Chrysler offered an optional stainless-steel muffler for $10. It was finally withdrawn for lack of takers.

Muffler life is only one of the headaches that the new breed of car engines has brought to the engineers who design the exhaust system. The customers want a hurricane in engine performance, but they complain if the sound is more than the whisper of a gentle spring breeze. The stylists make them longer and lower; the engine men bore the holes

[*Continued on page 238*]

New Ideas from the Inventors

1 Radio Warns of Low Tires. Unevenly inflated dual tires wear rapidly and often create serious highway hazards. To combat both faults, this recently patented invention would use a miniaturized radio transmitter and air-pressure switch in each valve cap. A receiver panel in the cab would warn of underinflation.

2 Ash Tray Douses Smokes. Closing this dashboard ash tray would automatically extinguish a smoldering cigarette. The cover and a meeting anvil would form a V-shaped trough; in closing, they would first crush out the butt, then part so it could fall into a receptacle below.

3 Sticky Sheet Cleans Type. An adhesive-plastic coating on a backing sheet might simplify type cleaning both on regular typewriters and on harder-to-service printing calculators. Type faces of individual keys, striking the tacky coating, would be cleaned of clogging ink.

Please turn the page for more new ideas

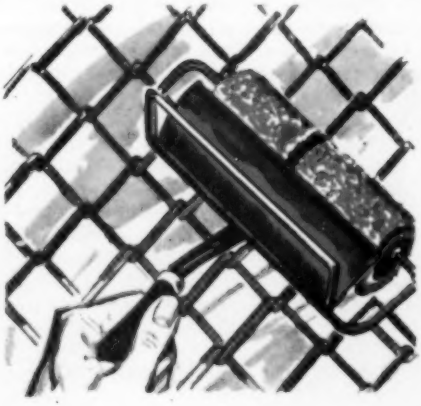
4 Liner Molds Shoe to Foot. By filling its sock-like lining with a plastic, you could mold the inside of this shoe to the exact contour of your foot. You'd first put on the shoe, then inject into the lining the plastic paste and a chemical that would speed up the setting time.

5 Brushes Clean Carriage Wheels. A baby carriage wouldn't wheel mud into the house if it were equipped with a set of these brushes to wipe the tires. Operated much like a brake, the brushes could be brought down into wheel-cleaning position by either a hand or foot lever.

6 Ignition Key Sets Brakes. A parked car couldn't roll downhill if its brakes were set automatically when the driver got out. One inventor suggests a solenoid to lock the brakes when the speedometer is at zero and a door is opened, or the ignition is turned off. Start the engine and the solenoid would release the brakes.

7 Eyedropper Helps Your Aim. With a mirror built into the cap of a medicine dropper, you might find it easier to squeeze the right amount of soothing liquid into the right spot in your eye. The reflector would be placed so you could see both your eye and the dropper tip.

8 Roller "Surrounds" Fence Wires. Each pass of this slotted paint roller would cover the sides as well as the tops of the laced wire strands commonly used in fences. By eliminating the necessity for brushing around the wires, the roller would shorten fence-painting time, reduce dripping, and give the fence both a neater appearance and better protection.



9 Wheeled Base Levels Tools. Machines, appliances or other heavy equipment could be quickly moved and leveled if they were mounted on these castered, semicircular swivels. When the turnbuttons were loosened and the table top leveled, the base would automatically compensate for floor unevenness or slope.

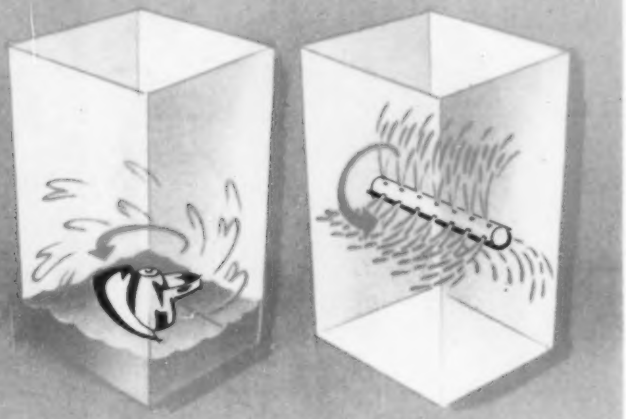
The following patents *have been issued on these inventions: 1. Patent No. 2,727,221 to E. A. Sprigg, E. Orange, N. J.; 2. No. 2,760,497 to A. D. Campbell, Tishomingo, Miss.; 3. No. 2,796,367 to E. G. Brown, Detroit; 4. No. 2,794,270 to B. B. Dubner, New Hyde Park, N.Y.; 5. No. 2,740,643 to R. Gordon, Brooklyn, and H. Hait, NYC; 6. No. 2,734,590 to R. A. Hays Jr., Atlanta; 7. No. 2,736,316 to J. B. Stovall, W. Hollywood, Calif.; 8. No. 2,735,128 to D. H. Adams, Holden, Mass.; 9. No. 2,722,428 to T. Longbotham, Portland, Ore.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

Consumer News

Modern machines wash dishes these five ways

Splash or spray? All automatic dishwashers do their job by splashing or spraying hot water over dishes. Vertical impellers are found in the greatest number. Spray tubes and wash arms pump water through tiny holes. Dual wash-arm method is new this year.



Which Dishwasher For Your Family?

A good one rates high in usable capacity, ease of loading, washing and drying efficiency

By Erik H. Arctander

LAST year a record half-million U. S. families threw in the sponge and mechanized their dishwashing chores. This fact is important to you. Here's why:

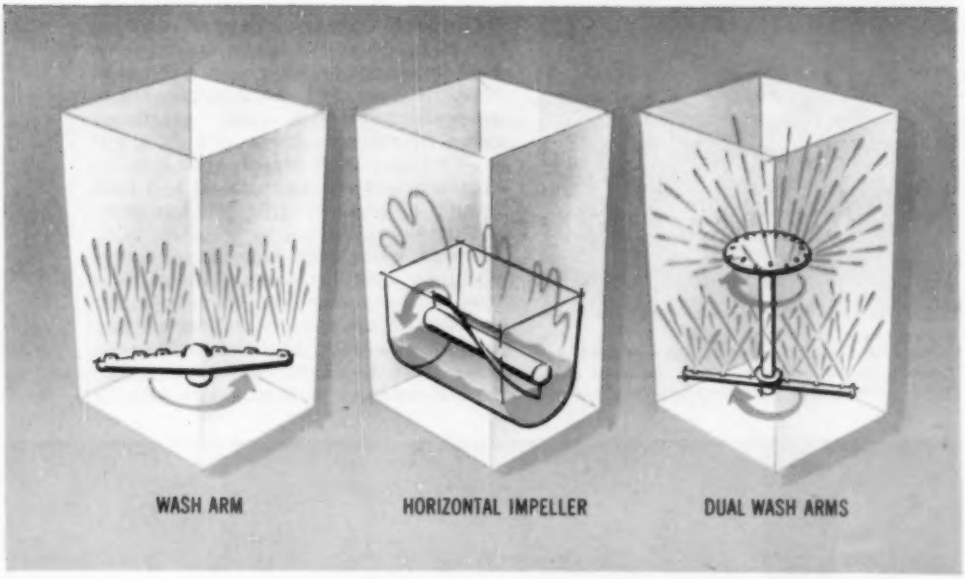
Husbands are taking a big hand nowadays in buying automatic dishwashers. No one seems to know whether they are doing it out of sympathy for their wives or from just plain selfish interest. But the trend is so plain that one major manufacturer has switched his advertising appeal from women to men.

Whether it's you or your wife who wants a dishwasher, buying one is very much a part of the husband's job. A dishwasher is an intricate machine. Choosing a good one takes just as much savvy as picking out a lathe for a home shop. The two machines, incidentally, are in the same price range.

Dishwashers come in five types. An under-counter model heads every manufacturer's line. This is the cheapest because it has only a front panel. In most cases the same mechanism also goes into three other types: the free-standing (separate-base cabinet) model, the combination dishwasher-sink, and the "stack-on," designed for use like a wall oven.

The fifth type—the portable model—doesn't always follow this pattern. Five makers do put their under-counter mechanism in a mobile case. But the rest sell a portable machine that's different from the other models in their line, both inside and out.

Dishwashers perform roughly the same



way regardless of brand or model. You open them up and load the racks—plates and pots in the bottom, glasses and silverware in the top. Dishwasher detergent goes in a special cup inside the machine or is dumped into a depression in the door. You close the machine and turn the timer knob, starting an automatic cycle.

To ensure really hot water and a better wash job, most dishwashers first run tepid water down the drain—the flush "prerinse." Then they fill the sump (bottom of tub) with hot water, and splash or spray it over the dishes, flushing detergent out of its container.

Dirty wash water then goes down the drain and the sump fills up with clean rinse water. This is splashed or sprayed around as in the wash phase. Usually, several short power rinses are used in succession, each one using fresh water.

The cycle ends with a drying period. Warm air—the heating-element wattage determines how warm—rises or is blown up through the dishes from below. The dry dishes may be left in the machine and

Some load from the top, others from the front

TOP LOADER slides out like a drawer, tub and all. You reach through top rack to load bottom.

FRONT LOADER'S hinged door opens down to let top and bottom racks slide out individually.

DISHWASHER CAPACITY is based on how many of these standard place settings it will hold. But don't judge solely by numbers. National Electrical Mfrs. Assn. set up measuring system.

taken out as needed by the housewife.

Capacity. Unless you have an extra-big family, or do lots of heavy entertaining, don't let capacity sway you too much. Most machines will easily handle breakfast and lunch dishes in one load, dinner dishes in another. A few will do a full day's accumulation. But this is a dubious advantage: Dried egg, oatmeal and milk develop a tenacious grip between dawn and dusk.

Numbers don't tell everything about a machine's capacity, either. Take a close look at the racks—will they hold the biggest serving platters, tallest glasses, bulkiest pots? The top rack is the one most likely to skimp on useful space. Some dishwashers with a modest capacity

Dishwasher Details (under-counter models)

MAKE	UNDER-COUNTER MODEL	APPROX. LIST PRICE	OUTSIDE DIMENSIONS (inches—width, depth, height)	CAPACITY (place settings)	OPENING	DETERGENT DISPENSER	WATER-FILLING METHOD
1. AMERICAN KITCHENS	DW2424	$300	24 x 23 x 34½	9	front	door pocket	timer
2. FRIGIDAIRE	DWUW	$320	24 x 24 x 34¼	10	front	rack cup	pressure switch
3. GENERAL ELECTRIC	SU-60R	n.a.	24 x 24½ x 34¼	10	drawer	auto. cup	timer
	SU-80R	n.a.	30 x 24½ x 34½	12	power drawer		
4. HOLIDAY	n.a.	$230	n.a.	8	front	none	pressure switch
5. HOTPOINT	MA6	n.a.	24 x 25 x 34½	8	front	auto. cups	amp.-meas. coil
	DE1	n.a.	24 x 24 x 34½	10	front	auto. cups	pressure switch
6. JAMES-UNIVERSAL	9918UC	$270	18 x 24 x 34¼	7	drawer	auto. cup	pressure switch
7. KELVINATOR	UDW	n.a.	24 x 23 x 34½	9	front	door pocket	timer
8. KENMORE (SEARS, ROEBUCK)	65D M6468	$240	24 x 23 x 34-7/16	9	front	none	timer
9. KITCHENAID	KD-12	$325	24 x 24½ x 34½	8	front	rack cup	timer
10. RCA WHIRLPOOL	DDW-240	$300	24 x 23 x 34½	9	front	door cup	timer
11. WASTE KING	UC-1C	$300	24 x 25½ x 34½	8	front	door cup	timer
	UC-1D	$350					
12. WESTINGHOUSE	DWD-24	$300	24 x 24½ x 34½	10	drawer	rack cup	timer
13. YOUNGSTOWN	DW-300	$300	30 x 23½ x 34⅝	14	front	door pocket	timer

NOTES: n.a.: This information not available.
*Includes timer adjustment, fill and drain time.

rating, their makers claim, handle more *big* pieces than machines rated larger.

Loading. Most dishwashers have an oven-type door that swings down, allowing two racks to slide out on rollers. Practically every such front opener has racks that move independently of one another. This speeds up loading because you can stack whatever comes to hand, without sorting the dishes first. The top rack glides in or out easily, letting you get at the proper rack for each item.

General Electric, James-Universal and Westinghouse under-counter machines are loaded from the top. You roll the complete tub out like a drawer and fill the bottom rack first. This is done by reaching through a hole in the center of the top rack. The top rack is stacked last. All portable makes except Frigidaire, KitchenAid and Waste King (which are front loaders) use the same top-loading procedure. This can be quite a stretch for housewives with a short reach.

Detergent cups are now standard in over half the dishwashers. They make it easier to measure out the right amount of powder—too much causes foaming, with reduced washing efficiency.

How they're filled. No dishwasher can work properly unless the right amount of water is in the sump. Manufacturers use three methods to fill the sump.

Simplest and most common method is the *time fill*. The timer opens a solenoid valve in the water-supply line. Hot water

WASHING MECHANISM	OPERATING CYCLE (F—simple flush; P—power spray)					WATER USED (gal.)	HEATING ELEMENT			OTHER MODELS WITH SAME WASHING UNIT
	Prerinse	Wash	Rinse	Dry	Total*		Type	Wattage	Heats Water, Air or Both	
vert. plastic impeller	F (1 min.)	10 min.	F (½ min.) 2P (3 min.)	16 min.	34 min.	6.3	sealed tube	750	both	free-standing, sink-comb.
horiz. rotating spray tube	F (¾ min.)	6¾ min.	2P (4½ min.)	27 min.	45 min.	9.3	sealed tube	600	both	free-standing, portable, sink-comb.
vert. steel impeller	2P (5½ min.)	7¼ min.	3P (9 min.)	14¾ min.	37 min.	10 / 12.5	sealed tube	600	both	free-standing, portable
vert. revolving wash arms	none	6 min.	2P (6 min.)	10 min.	22 min.	3	sealed tube	n.a.	both	none
vert. plastic impeller	none	10 min. (2)	2P (2 min.)	30 min.	50 min.	8	sealed tube	850	both	free-standing
dual revolving wash arms	as above, plus no-drying utility cycle:				16 min.	10	sealed tube	700	both	
horiz. steel impeller	2F (5 min.)	6⅔ min.	P (2⅓ min.)	none	14 min.	6	sealed tube	600	water	portable, countertop
vert. plastic impeller	F (1 min.)	10 min.	F (½ min.) 2P (3 min.)	16 min.	34 min.	6.3	sealed tube	750	both	free-standing, sink-comb.
vert. plastic impeller	F (1 min.)	10 min.	F (½ min.) 2P (3 min.)	16 min.	34 min.	6.3	sealed tube	750	both	free-standing
horiz. revolving wash arm	F (1½ min.)	7 min.	2P (3¾ min.)	25½ min.	43½ min.	9.5	open cone	1,000	air	free-standing, portable, sink-comb., stack-on
vert. plastic impeller	F (1 min.)	10 min.	F (½ min.) 2P (3 min.)	16 min.	34 min.	6.3	sealed tube	1,000	both	free-standing
horiz. revolving wash arm	F (¾ min.)	10½ min.	F (¾ min.) 2P (8¼ min.)	24 min.	45 min.	8	sealed tube	750	both	free-standing, portable
	F (2 min.)	8 min.	F (1 min.) 2P (6½ min.)	13 min.	37½ min.	9	sealed tube	1,350	both	
vert. plastic impeller	F (1½ min.)	5¼ min.	2P (3 min.)	25½ min.	45 min.	8	sealed tube	750	both	free-standing, sink-comb.
horiz. rotating spray tube	none	5 min.	F (1 min.) P (2 min.)	19½ min.	27½ min.	8	sealed tube	900	both	stack-on

runs into the sump at a steady rate, through a constant-flow valve. When the timed interval ends, the solenoid valve closes the line and the sump is full.

Some machines use a *pressure-sensitive switch* at the bottom of the sump. When water has filled the sump, its weight (head pressure) exerts just enough force to close the switch and shut off the fill line. This method has the advantage of being unaffected, as constant-flow valves sometimes are, by chronic low water pressure or a sudden drop caused, for example, by an opened faucet.

Another system that gets around water-pressure differences is the *measuring coil* used in some Hotpoint models. While water rises in the sump, the machine's impeller revolves. The more water the impeller must churn, the more current the impeller motor draws. When current drain gets heavy enough to indicate a full sump, the measuring coil signals the solenoid valve to close the fill line.

Washer action. In most machines, a plastic impeller that looks like a miniature ship's screw *splashes* the water around. Wash arms that *spray* the water under pressure are used in four makes: Holiday, KitchenAid, Waste King and one Hotpoint model. Two brands—Frigidaire and Youngstown—pump the water through a rotating spray tube mounted between racks. James-Universal splashes water with a horizontal screw-type impeller of stainless steel.

Deciding which washing action does the best job is one of the toughest, yet most important, decisions you will have to make in choosing a machine. Though designers still don't agree on a single best washing method, the two newest dishwashers to come on the market may be straws in the wind.

Holiday and the Hotpoint DE 1 both use two wash arms. Holiday has one on each side of the tub; they revolve in a vertical plane. The new Hotpoint has horizontally revolving arms, one below the bottom rack and the other between racks.

The kind of washing action you get affects more than just the cleanliness of your dishes. It also determines the work hazards of a dishwasher's key part: the motor. A new one costs about $30, plus service charge.

The motor's worst enemy is straying silverware that jams the washing mechanism. A jammed wash arm, propelled hydraulically by a pump, merely stops; water continues to spurt out of the holes without straining pump or motor. A spray tube, though mechanically driven, presents a very small and slippery target. But impellers don't fare so well in bouts with cutlery. When jammed they could burn out the motor windings.

All machines using a plastic impeller have a thermal cutout on the motor that opens the circuit if motor windings overheat. GE's steel impeller is designed to flip silverware out of the way.

Operating cycle. The brain of every dishwasher is a synchronous motor that closes electrical contacts in a timed sequence. All of these timers can now be overridden manually. That means you can add a rinse or skip one, shorten the drying cycle or extend it. Door interlocks are standard too; if you open the machine to add one last plate, wash action stops.

There is no substitute for really hot water from your own supply line. It takes a temperature of at least 140 degrees to wash off grease and kill germs. Up to 160 degrees is even better, but don't go higher—experiments show that soiling material gets baked onto the dishes.

While some manufacturers let you believe that their heating elements bring tepid water up to par, the more candid ones consider their heat tubes as temperature maintainers. They point out that it takes a minute for most heating elements to raise the temperature of a sump full of water one degree. At the end of a five-minute wash, for example, the water would be only five degrees warmer.

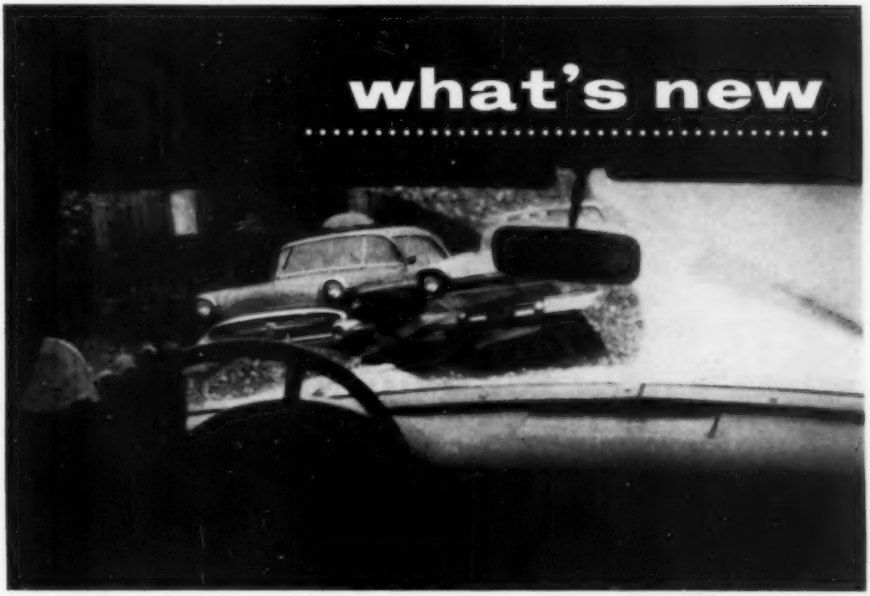
Westinghouse and the deluxe model Waste King guarantee hot enough water by holding up part of the cycle until a thermostat allows it to continue. Westinghouse won't wash or give a final rinse in less than 140-degree water. Waste King's second rinse uses 160-degree water.

Some housewives are horrified at the amount of hot water dishwashers use. Actually, appliance makers point out, the average clothes washer uses four times as much per load.

Drying. Machines vary widely in drying ability. At one extreme is the James-Universal, which lets normal evaporation do the job. At the other is KitchenAid, whose open-wire, cone-type heating ele-

[*Continued on page 242*]

cations, announced by General Electric, run directly on a car's battery, requiring no generator or vibrator-type



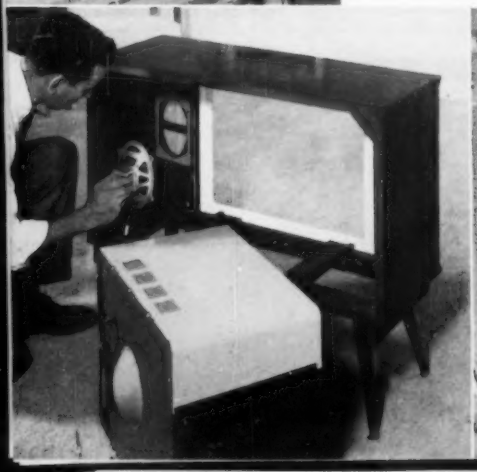
for your car A product originally developed to keep eyeglasses clear now prevents ***annoying windshield fogging.*** Shown being tested by POPULAR SCIENCE above, the chemical was rubbed on the inside left-hand half, which remained clear, while the untreated right-hand half quickly fogged. The secret? It acts as a wetting agent, keeping moisture running off instead of forming into tiny droplets. Made by Modern Products, it also keeps bathroom mirrors and house windows from steaming . . . A ***delayed-action switch*** keeps your headlights on long enough for you to walk from car to house, then shuts them off. The Cauhorn switch costs about $4 . . . You can add ***extra sleeping room in station wagons*** with the tentlike tailgate extension shown below ($17). It's made by Morsan Tents to fit all wagons. A larger all-canvas model, for $22, also covers the side windows for roadside privacy . . . ***First transistor-powered two-way radios*** for mobile communi-

More new products on the next page

cations, announced by General Electric, run directly on a car's battery, requiring no generator or vibrator-type power supply . . . ***Plastic spare-tire covers and trunk mats,*** at left, keep luggage space tidy in all Chrysler-line cars for '57 and '58. Also available for Chrysler-line cars are new ***door guards,*** styled to look like trim strips, that protect your paint against nicks and scratches from other car doors in close parking quarters . . . ***A retractable trailer hitch,*** made by Atwood, swings out of the way under the bumper when not in use . . . You can put a convertible top down earlier this spring, say the makers of a ***clear-plastic wind screen*** designed to stop chilly pre-season drafts. The Continental screen stretches across the back of the front seat.

what's new for your home

Two neat window ideas: ***Removable cross-strips*** at left snap out of bullet catches on the inside of the sash for easy washing, painting, even restyling of windows for a Colonial or modern effect. They're available on new Rol-screen windows or for mounting on existing windows. ***An all-aluminum "tack-on" window,*** made by Ceco Steel, requires no framing—you just nail it to the side of the house . . . Watch for two new containers to appear this year: ***aluminum food cans*** by Kaiser, and ***stack-together medicine bottles*** made by Celluplastic to save space in overcrowded medicine cabinets . . . Bissell's new ***carpet cleaner*** shampoos a rug as it's rolled over it like a sweeper. Said to clean a 9′-by-12′ carpet in 25 minutes, it sells for about $15 . . . Your wife may need a pilot's license to run a new Berns ***stove hood.*** It has: a built-in radio, three-speed fan and light—all of which add up to $64 and more controls than a B-29 . . . Sylvania's ***convertible TV,*** at lower left, switches from living-room console to playroom "portable" by sliding out the removable innards. Prices for the 21″ set start at $230 . . . ***All-in-one kitchen*** for recreation room or a summer cabin packs sink, refrigerator and three-burner range into the single, 29″-wide unit below, at right. Made by General Air Conditioning, for about $500, it also comes in models with an oven, broiler, even a garbage disposer.

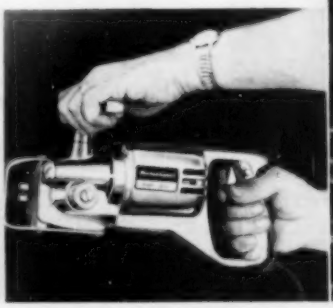


for the home shop

Watch at hardware stores for ***non-clogging steel "sandpaper,"*** the latest of several recent new abrasives. Said to work three to four times faster than ordinary sandpaper and last many times longer, it gets its cutting action from thousands of tiny punched holes (shown enlarged about seven times at right), which can't clog because shavings pass through. Made by Red Devil, it comes in small 4″-by-5″ sheets to fit their regular sandpaper holder or for separate use on blocks and dowels. Larger sheets for orbital sanders are planned for later this year. Grit size, roughly equal to medium sandpaper, may also be made in coarser and finer grades.

If you have trouble remembering how many quintals to a pound, there's ***a free wall chart of conversion factors*** that will tell you. It's available from Precision Equipment Co., 4401 N. Ravenswood Ave., Chicago, and includes common as well as many hard-to-find measuring equivalents . . . A new ***trigger control*** on Turner's propane soldering torch automatically reduces the flame to a low idle between jobs so you save fuel without resetting the main feed valve each time . . . For regular soldering irons, there's a ***copper-alloy solder*** that prevents absorption of the iron's copper tip because the solder itself contains copper. Introduced from England by British Industries, it's said to make irons last 10 times longer than when used with conventional tin-lead solder . . . Belsaw is pioneering a new ***one-man sawmill*** that takes any rough stock up to 6″ thick, rips it to any width, planes on a cabinet finish and molds it to any of several shapes—all in a single pass. Price: under $300.

You can cut clear through a house wall with the ***extra-long-reach blade*** on Porter-Cable's reciprocating electric saw below. It stabs its own starting hole and saws to a remarkable depth of 11⅛″. Other blades cut scrolls, pipe, sheet metal and many other materials. The rugged, 3½-amp tool sells for about $100.

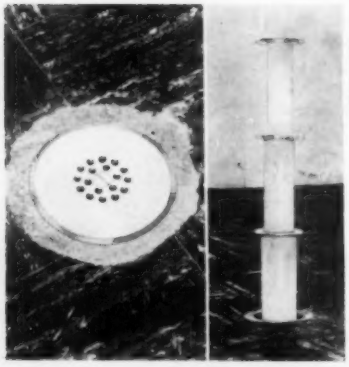


More new products on the next page

what's new for the handyman

Self-powered sulky at left converts a push mower into one you can ride behind in leisure. A 2½-hp. gasoline engine buckets it along at up to five m.p.h. and has a single reverse-neutral-forward shift control. When not pushing, the sulky can be fitted with auxiliary front-end wheels to become a baby tractor for hauling a cart, fertilizer spreader and other attachments. The Lawn-Boy sulky can be used with the company's own line of mowers as well as with other makes. It sells for about $170 . . . Clemson, which isn't putting all its eggs in the power-mower basket, has added a new ***16" hand mower***, for $24, upping to four the muscle-driven models it now offers. The company also makes reel and rotary power mowers . . .

You can paint pipes, gutters, downspouts and other curved surfaces with a new ***flexible paint roller*** made by E Z Paintr. It comes in a large size for $8, a smaller one for $3 . . . You can steal ***extra storage space in a garage*** by setting up a collapsible steel rack at one end. Made by Bernard Franklin, the storage rack is just high enough to let you drive the front of your car under it . . . If water backs up into your cellar, the ***telescoping plastic drain*** at left automatically pops up out of the floor, acting as a standpipe to prevent flooding. A one-way valve lets water flow down it, but not back up. The Sewer-O-Matic drain fits standard 3" or 4" drainpipes and sells for about $13 . . . Special ***closet-building brackets***, made by McKinney, support a shelf on top and have hooks on the ends to hold a clothes pole . . . You can buy a small ***powered home cement mixer*** for about $35 and add your own ¼-hp. motor. The wheeled mixer weighs 72 lb., mixes a sack of cement in about two minutes. Made by Beran, it is also sold complete



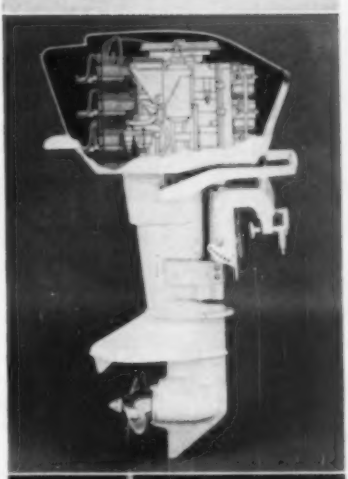
for more information:

Here's where to write if you can't get any item listed above: **Atwood Vacuum Machine Co.**, *Rockford, Ill.;* **Bassick Co.**, *437 Howard Ave., Bridgeport, Conn.;* **Belsaw Machinery Co.**, *3251 Field Bldg., Kansas City, Mo.;* **Beran Mfg. Co.**, *906 Dullnig Court, San Antonio, Tex.;* **Bernard Franklin Co.**, *Medley & Bath Sts., Philadelphia, Pa.;* **Berns Air King Corp.**, *3050 N. Rockwell St., Chicago;* **Bissell Carpet Sweeper Co.**, *Grand Rapids, Mich.;* **British Industries**, *80 Shore Rd., Port Washington, N. Y.;* **Cauhorn Dist. Co.**, *20722 W. Seven Mile Rd., Detroit;* **Ceco Steel Products**, *5601 W. 26th St., Chicago;* **Celluplastic Corp.**, *Newark, N. J.;* **Charles Beseler Co.**, *219 S. 18th St., East Orange, N. J.;* **Chrysler Motors**, *7000 E. Eleven Mile Rd., Center Line, Mich.;* **Clemson Bros.**, *Middle-*

with motor for $50 . . . The ***saddle-stitching stapler*** at right has a long curved slot in the base that lets you get staples into hard-to-reach spots, as when fastening papers at the fold line. The base also swings out of the way so the Lansdale stapler can be used as a tacker . . . ***Want to win $25,000?*** A new contest challenges you to find the improvements your home needs, then write a 25-word explanation of why they're important. You can get entry blanks at participating hardware stores or from the Home Improvement Council, P. O. Box 810, Chicago 77. A total of $125,000 in prizes is waiting for the lucky winners of the householders' competition.

just for fun

New slicked-up outboards are getting more like cars every day. Scott-Atwater's radical ***three-cylinder in-line engine***, first in the U. S., has separate carburetion for each cylinder and automotive-type ignition. The 60-hp., 160-lb. motor is said to rival many larger engines weighing 200 lb. or more. Three other S-A "firsts": ***electrical power steering***, a single ***shift-throttle control***, and a ***remote motor lift*** that tilts the prop up for beaching . . . Air springs, just out in some '58 cars, are already on a new ***adjustable-load boat trailer*** made by Bassick. Spring stiffness can be adjusted for any weight of craft up to 1,400 lb. simply by varying the air pressure.



To spur sales, the Charles Beseler Co. offers ***a complete darkroom kit*** with its 23C enlarger, said to be a $300 value for $195 . . . You can make ***black-and-white prints from color negatives*** on a new Eastman Kodak enlarging paper that reproduces normal tones not possible on ordinary paper . . . Ronson's improved ***butane gas lighter*** has come a long way from earlier models. It has an adjustable jet (it uses no wick) that varies flame height, and can be refilled at any time without waiting for the tank to "go dry." It runs several months on a single filling. Prices start at about $15.

Sheldon Gallager

town, N. Y.; **Continental Industries,** *684 N. Sangamon St., Chicago;* **Eastman Kodak,** *Rochester, N. Y.;* **E Z Paintr Corp.,** *4051 S. Iowa Ave., Milwaukee, Wis.;* **General Air Conditioning,** *4542 E. Dunham St., Los Angeles;* **General Electric,** *Syracuse, N. Y.;* **Kaiser Aluminum,** *1924 Broadway, Oakland, Cal.;* **Lansdale Products,** *P.O. Box 568, Lansdale, Pa.;* **Lawn-Boy,** *Lamar, Mo.;* **McKinney Mfg. Co.,** *1715 Liverpool St., Pittsburgh, Pa.;* **Modern Products Co.,** *714 E. 51st St., Brooklyn, N. Y.;* **Morsan Tents,** *10-27 50th Ave., Long Island City, N. Y.;* **Porter-Cable Machine Co.,** *112 Exchange St., Syracuse, N. Y.;* **Red Devil Tools,** *2400 Vaux Hall Rd., Union, N. J.;* **Rolscreen Co.,** *Pella, Iowa;* **Ronson Corp.,** *31 Fulton St., Newark, N. J.;* **Scott-Atwater,** *2901 E. Hennepin Ave., Minneapolis;* **Sewer-O-Matic,** *5926 S. Racine Ave., Chicago;* **Sylvania Electric Products,** *1740 Broadway, NYC;* **Turner Brass Works,** *Sycamore, Ill.*

Electric handsaw:

Home and Shop

Year's Most Exciting Power Tool

By Sheldon M. Gallager and Ralph Treves

ALMOST overnight, the electric handsaw has become one of the fastest-moving hardware items in the U. S. More and more manufacturers are putting their money on it as a power tool you're likely to buy soon. Some expect it to equal the quarter-inch drill in popularity.

Although invented more than a decade ago, the electric handsaw has just now begun to show up in big numbers. You may have known it as a portable jigsaw or saber saw. Today manufacturers no longer plug it only as a saw for fancy scrollwork. They are also exploiting its remarkable ability to cut through two-by-fours, joists, rafters, big plywood panels, iron pipe, sheet steel, plastics, leather, hardboard—in short, any material that's cuttable by any other type of saw.

The electric handsaw has become an all-purpose tool you reach for and use as casually as an ordinary handsaw. While not as fast-cutting as a portable circular saw, it is no slouch. In speed tests, several makes zipped through two-by-twelves in 15 to 60 seconds—fast by any standard.

For long rip cuts, there's a guide that rides the edge of the board to keep the saw straight. For crosscuts, you clamp a straightedge to the work.

One contented user says: "I bought the saw just for jigsaw cutting, but now I use it for almost all wood cutting."

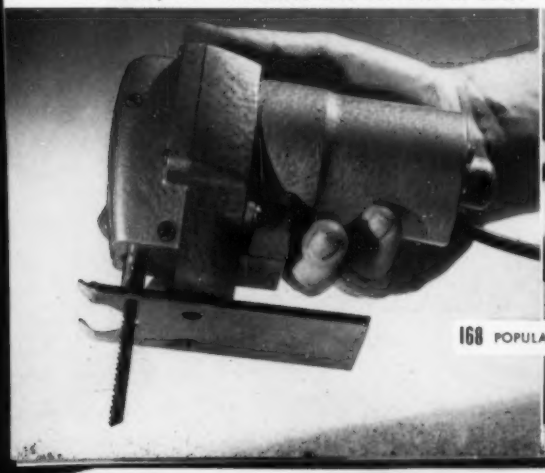
Sales have skyrocketed. More than a dozen manufacturers have rushed new models into production, many for the first time this year. The tool you couldn't touch for less than $160 a few years back now comes in a wide price spread, with some models down to less than $25.

From about 20,000 saws a year some time back, sales have zoomed to well over 100,000 in 1957. And this year, several makers plan to sell from 50,000 to 100,000 saws *apiece*—all told, between eight and 10 million dollars' worth. Of these, two manufacturers are already selling a million dollars' worth a year. A third maker, intending to avoid shortages, stockpiled 30,000 of the tools before even putting them on the market—and was still swamped. Another sold 2,000 of the saws in three days at a hardware show.

Stanley, a newcomer to the field this

IT'S INEXPENSIVE: Forsberg's new G-Whiz below is priced at only $25. Whiz-Saws were the first American-made electric handsaws. They appeared soon after the Swiss-made Scinta (now Lesto) was introduced into the U.S. in 1945.

IT'S VERSATILE: A toothless blade designed to cut rubber, fabric and other soft materials is one of more than 20 special blades now available for handsaws. It's shown below on one of Black & Decker's two handsaw models.



NAMESAKE: This 5¼-lb. Disston bears the handle and the name of the famous Disston D-23 handsaw. It has a rip guide, a tilt base for bevel cuts, even interchangeable power cords up to 100′ long. In the background is one of the original D-23 handsaws, made about 1850.

year, is convinced that the electric handsaw will eventually become "as essential a part of the workshop tool kit as we consider the electric drill today."

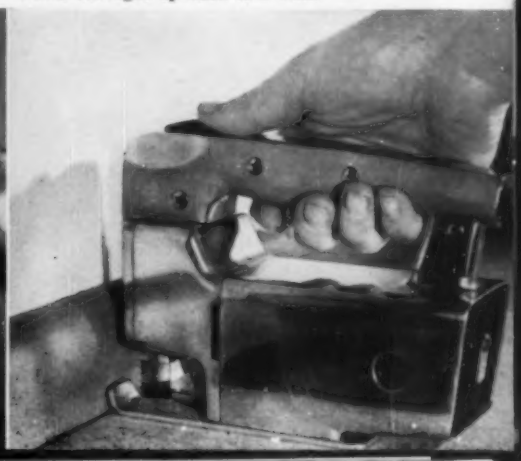
One of the oldest sawmakers in the country, the Disston Division of the H. K. Porter Company, sees the tool as the "modern handsaw." Its new powered D-23 is the first of several electric models the company will introduce.

Disston's decision to enter the power field was influenced in part, incidentally, by the enthusiastic response from prospective tool buyers in a survey recently conducted by POPULAR SCIENCE.

Another large toolmaker, well known

IT'S HANDY: Kept plugged in on a workbench, an electric handsaw is always ready for use when you need it. Several makes, like this Porter-Cable, provide wall brackets for storing saw and attachments within easy reach.

IT WORKS ANYWHERE: Tiny up-and-down blade enables you to reach in tight spots where other saws can't go. An added feature on this Stanley model is a retracting base shoe that lets the blade cut right up flush to a wall.



for portable circular saws but asking anonymity, admits: "We're already selling just as many electric handsaws as portable circular saws. Eventually the self-powered handsaw should outsell the circular saw by at least three to two."

Peter Terzick, editor of *The Carpenter*, official magazine of the United Brotherhood of Carpenters, reports that the electric handsaw "definitely fits the need of the carpenter for certain jobs and is actually preferable to the portable circular saw in many cases."

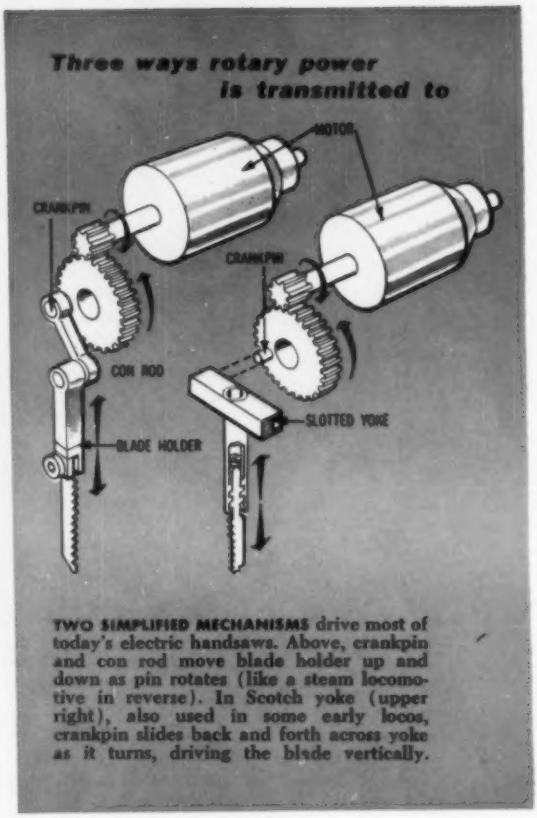
Makers and users of the saw attribute its popularity to three factors—light weight, safety, relatively quiet operation.

At three to five pounds, it can be swung easily overhead and maneuvered into awkward places where neither a handsaw nor circular saw will go.

Hardware salesmen report that the blade's tiny teeth and short stroke don't hold the terror for careless fingers that an improperly used circular blade can.

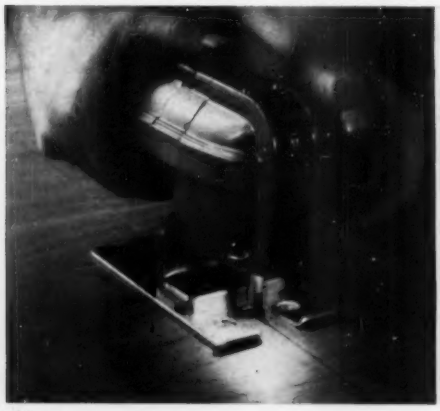
One large power-tool dealer on Long Island confides that it's the only tool he'll let a buyer try without instruction. Another dealer, confident of booming sales, says: "How can you *not* sell a tool that in large part replaces the handsaw, hacksaw, portable circular saw, bandsaw, jigsaw, coping saw and keyhole saw—all rolled into one neat, handy package?"

"I can saw on Sunday." Ardent advocates of the electric handsaw also point

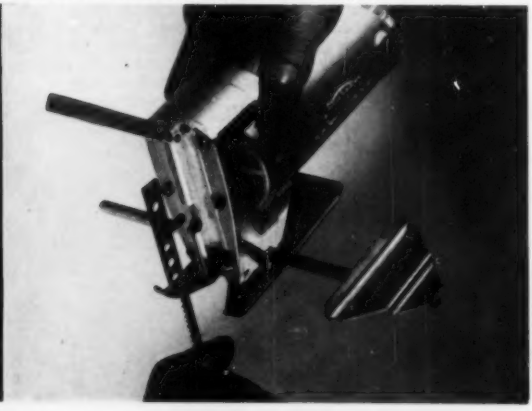


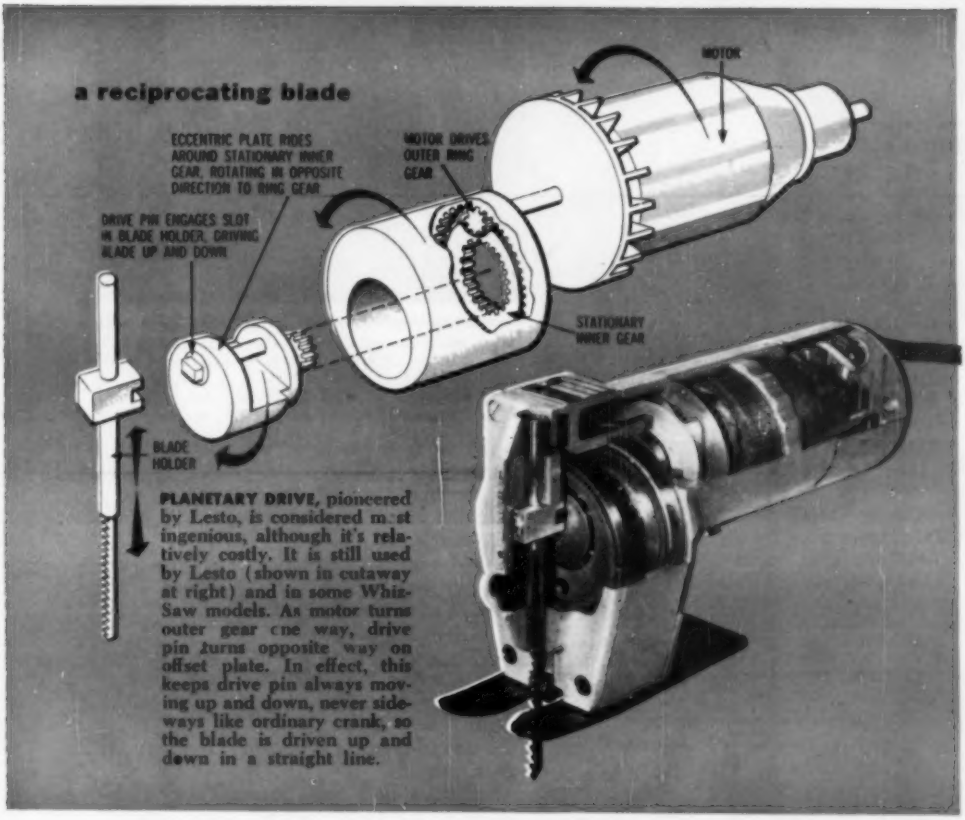
TWO SIMPLIFIED MECHANISMS drive most of today's electric handsaws. Above, crankpin and con rod move blade holder up and down as pin rotates (like a steam locomotive in reverse). In Scotch yoke (upper right), also used in some early locos, crankpin slides back and forth across yoke as it turns, driving the blade vertically.

BUILT-IN GUIDE LIGHT is one of newest refinements in modern electric handsaws. This Shopmate model also has tilting base, rip guide and circle cutter, sells for less than $30. Side knob allows use with two hands for delicate work.



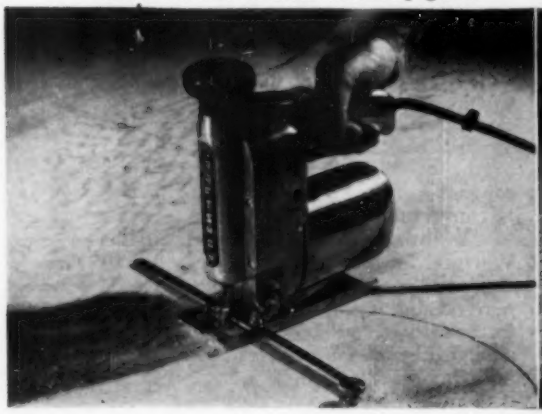
QUICK-CHANGE BLADES in the new Sunbeam let you switch instantly to wood, metals, plastics and other materials. Blade holder snaps open and blade is simply slipped in place, requiring no chuck or locking screws to adjust.



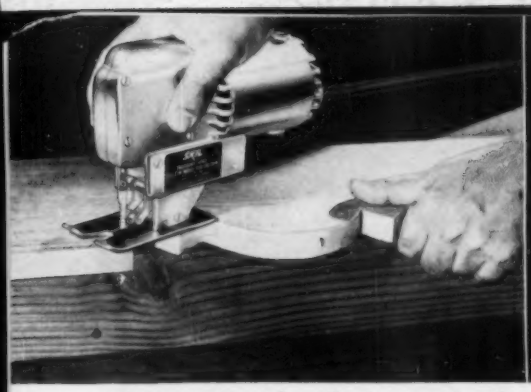


PLANETARY DRIVE, pioneered by Lesto, is considered most ingenious, although it's relatively costly. It is still used by Lesto (shown in cutaway at right) and in some Whiz-Saw models. As motor turns outer gear one way, drive pin turns opposite way on offset plate. In effect, this keeps drive pin always moving up and down, never sideways like ordinary crank, so the blade is driven up and down in a straight line.

PERFECT CIRCLES, no longer cut freehand, are automatic. Most electric handsaws come with a circle-cutting pivot arm, like this Sears Craftsman, or provide them as extras. The one below can also be fitted with a rip guide.



ABILITY TO CUT OWN STARTING HOLE is one of the main features that made the electric handsaw famous. You simply rock the blade into the work, as demonstrated by the Dalton saw below, until the blade cuts its way through.



INTRICATE CUTS made with ease earned early electric handsaws the name "jigsaw"—just one of many jobs they do today. As shown by this Skil model, capacity of cut is not restricted by a conventional jigsaw or bandsaw throat.

HOW FAR THEY'VE COME is indicated by a neat trick on Millers Falls saw above. You can't lose chuck key—it's built into removable hand knob on top. A stationary saw table is available on this handsaw as well as several other makes.

HOW PRICES COMPARE

ADDITIONAL electric-handsaw models will be put on the market from time to time. The saws below are among those currently available.

Make	Model	List Price
Black & Decker	U-10 U-11	$ 54.50 115.00
Dalton	D-500 D-600	44.95 29.95
Disston	D-23	98.50
Electro Engineering	JS-50 E-200	34.95 34.95
Forsberg (Whiz-Saw)	G-Whiz 1 2 10 15	24.95 55.00 130.00 34.95 79.95
Lesto	GEB-4 GEB-11 GEB-13 GEB-14	62.50 138.50 155.00 99.50
Millers Falls	480	49.50
Montgomery Ward (Powr-Kraft)	8920	24.95
Pet	2000	49.95
Porter-Cable	152 548	54.95 99.50
Sears, Roebuck (Craftsman)	2794 2798	32.88 52.44
Shopmate	2100	29.95
Skil	511 514	54.50 47.50
Stanley	H-75	54.50
Sunbeam	76	45.00
Weller	800	19.95
Wen	505	29.95

out that it is perhaps "the most socially acceptable power saw ever made." Instead of the high-pitched, jarring scream of a circular saw, it makes a relatively quiet *put-put* sound.

One weekend carpenter likes it because "I can saw outdoors, on Sundays, even late at night without disturbing my own family or the neighbors."

Why the sudden boom? Hard to say. The electric handsaw has been around ever since the first Scinta saw (now called Lesto) was brought over in 1945 from the world-famous Scintilla Company in Switzerland.

Scintilla had been attempting to develop a "portable jigsaw," little dreaming it would become the husky, all-around workhorse that it is today. The development of tiny, high-speed electric motors for wartime aircraft and submarines had led to the discovery that a motor could be made small enough to fit in your hand. The unusually high motor speed—from 14,000 to 22,000 r.p.m. (several times faster than the average electric drill)—was essential because the final geared-down blade speed was reduced to 2,500 to 4,000 strokes a minute.

An ingenious, though expensive, arrangement of planetary gears was devised to convert the rotary motion of the motor to the straight-line motion of the blade. Wartime advances in metallurgy licked the final problem—producing a blade hard enough to stay sharp, flexible enough to bend without breaking, and tough enough to withstand the tremendous heat and friction of cutting.

Scintilla soon had a competitor. Fors-

berg, working in this country, brought out its now-famous Whiz-Saw, using a similar version of the still-expensive planetary-gear drive. Prices of both tools ranged well over $100.

The pros made it pay. Early sales went to a small and strangely assorted group of professional users, among them stagehands, builders, heating, plumbing and electrical installers. Sheet-metal workers fitted their tools with hacksaw blades.

As sales increased, more and more manufacturers began experimenting with simpler drive mechanisms, which, while hopefully cheaper, brought problems of vibration and wear. Several makers worked years just to devise a balanced motor that would withstand the rapid oscillations of the blade. Both Forsberg and Lesto retain the planetary drive in their highest-priced saws, but offer less expensive models using a crank or Scotch-yoke drive.

Makers of electric drills have also been quick to hop on the bandwagon by providing jigsaw attachments for their drills.

New features came thick and fast. The rising popularity of the electric handsaw has also brought changes in its personality. Many manufacturers have added handles, rip guides and adjustable tilt bases for making bevel cuts.

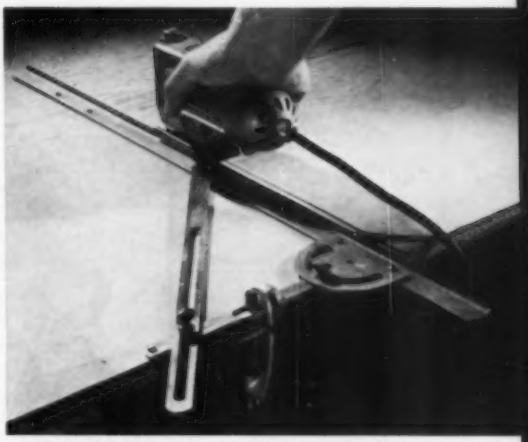
What do you get for the money? While prices of electric handsaws vary widely, they do fall roughly into three groups depending on the type of tool that fits your particular needs.

The newer low-priced saws from $20 to $30 are designed for weekend work around the home and stand up well under occasional use. They'll do most jobs that higher-priced saws will do, but they usually have lighter-duty sleeves instead of ball bearings and may be limited to one-inch stock.

For heavier work, you can get models in the $45 to $60 range that have rugged ball-bearing construction and handle full two-inch stock. Top-bracket saws, for $100 or more, are designed for both home and professional users who must run them hours at a time. They have heavier motors, usually cut somewhat faster than lower-priced saws, and frequently handle thicker stock.

No matter what the need, electric-handsaw enthusiasts are certain there's a model that will meet it. END

BEVEL CUTS up to 45° can be made with this tilting-base accessory for Porter-Cable saws. For square cuts, a fixed flat base is used. Tilt bases are also obtainable for several other makes, usually as standard equipment.

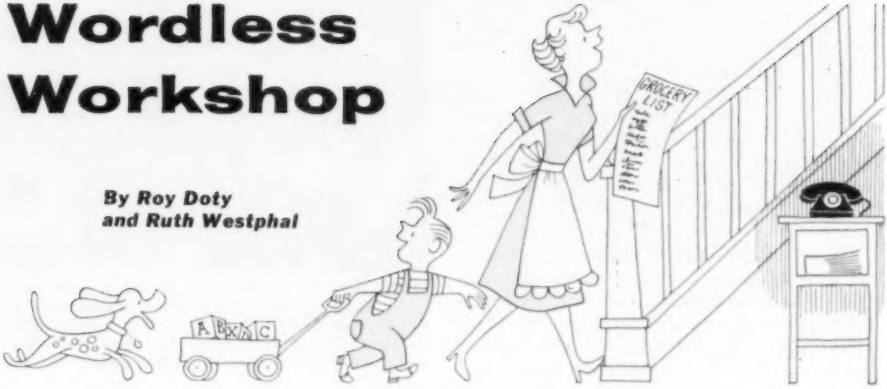


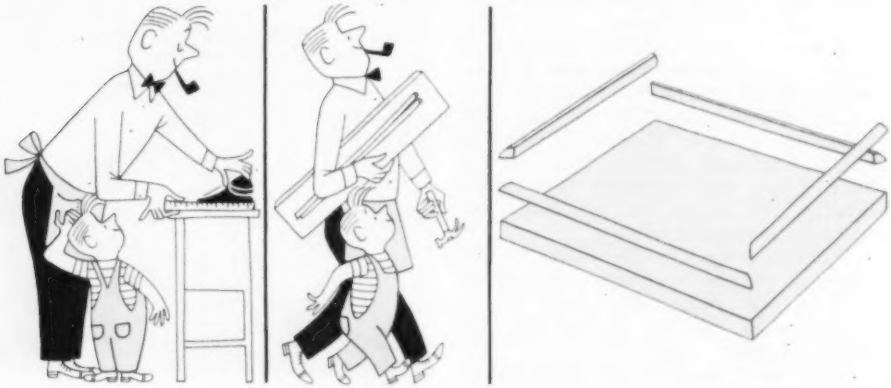
LONG CROSSCUTS AT ANY ANGLE are made accurately with protractor guides like this one for Whiz-Saws. Base of saw is grooved to slide along the guide rail automatically. Cross brace locks setting against accidental slippage.

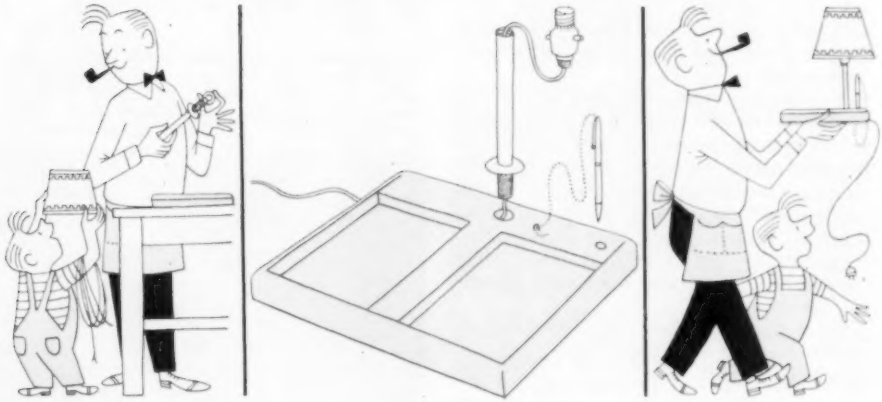
LOWEST-PRICED SAW TODAY is this vibrator-type Weller for $19.95. Since motor gives straight rather than rotary motion, no complex blade drive is needed. Saw cuts 1" wood stock, hardboard, aluminum and other nonferrous metals.

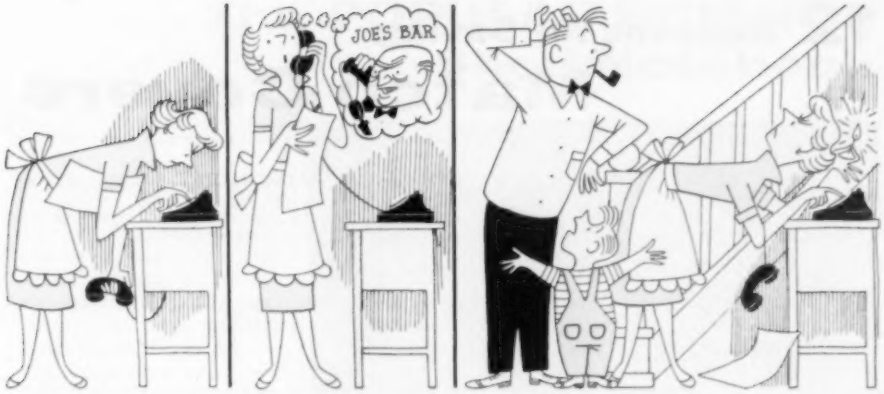
Wordless Workshop

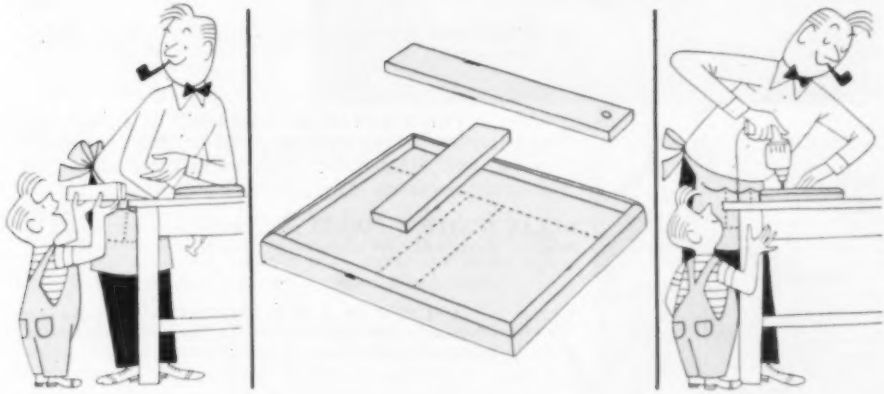
By Roy Doty
and Ruth Westphal





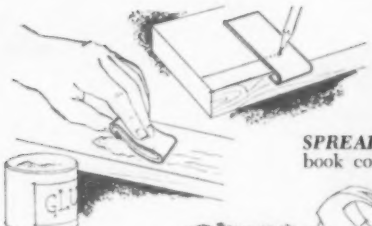






Next Month: Removable ramps for rolling a mower out of the cellar

12 Reasons for Saving Match Covers



USE AS A MARKING GAUGE. Measure the desired dimension from the scratching surface and make a pin hole in the cardboard. Insert a pencil in the hole and draw it along the board.

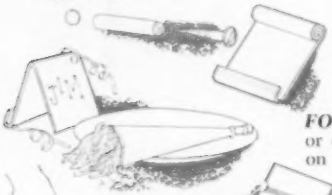
SPREAD GLUE EVENLY by using the rounded end of a book cover with a light wiping motion.

START A TACK where fingers won't reach by putting it in a slit in the cover's end. Withdraw the cover after the first hammer tap.

KEEP SCREWS IN ORDER when doing a repair job by threading them into an empty cover. Punch holes in it first.

USE A COVER AS A CRADLE for a small sable brush when painting models or striping. Cut two notches in it and stand it on edge.

CLEAN IGNITION POINTS or contacts in a thermostat by rubbing them with the abrasive portion of a matchbook.



A SCREW IN A PLASTERED WALL always presents a problem. Solve it by inserting a dampened cover in the hole, then driving the screw.

FOR A NOTE that can be spotted quickly when you're away, or even for a place marker at a party, write message or name on a matchbook turned inside out. Prop it up conspicuously.

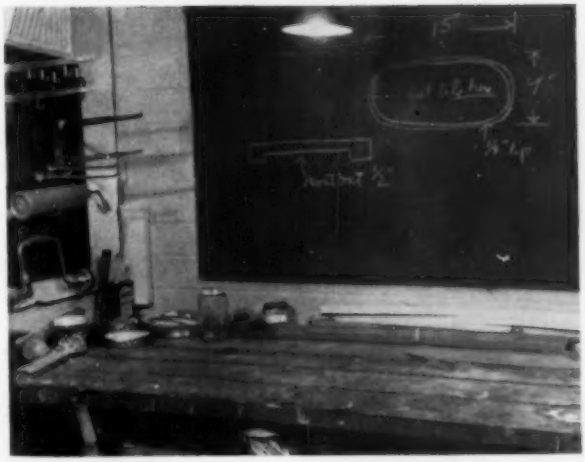
SEWING KIT for office or camping trips can be made by pressing needles into the inside and wrapping the flap with thread.

NEED A SHOEHORN? Use a matchbook. It's smooth and flexible enough to slide your heel into the tightest shoe.

TO MARK YOUR PLACE in a book use a matchbook opened out instead of bending down a page. Striking edge makes it slip-proof, too.

TO FOCUS A CAMERA on an object with no sharp lines to define, stand the printed side of a matchbook facing the camera —it makes a good target for fine focusing.

The POPULAR SCIENCE Shop Notebook



A blackboard over your bench is handy for making notes, working out the details of a project and preparing a list of needed materials. If you happen to have a slate blackboard, that's fine—but otherwise you can paint over a panel of 1/8" hardboard or plywood with several coats of a specially prepared blackboard paint available in most paint stores. Fasten the board to the wall with masonry fasteners.

Have you a worn oilstone that's been hollowed in its center by years of use? A flat surface can be restored to it in this way: Sprinkle abrasive grit on a steel plate and rub the stone over it in a circular motion until the high spots are lapped off. Use 60 to 80 grit abrasive; coarser may make the stone too gritty for fine honing.—*H. Gilbert, Enid, Okla.*

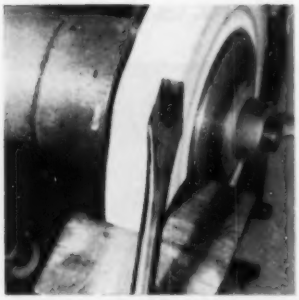
An old tank-type vacuum cleaner, fastened to a centrally located wall, speeds tidying up your shop after an evening of work. With an extra hose coupled to the original one, you'll probably be able to reach most of your workshop area without moving the vacuum tank.—*J. C. Branstetter, Colma, Cal.*

Need storage for brads, small bolts and screws? Accumulate a quantity of flip-top cigarette boxes, or have friends who smoke save them for you, and pack them in a carrying case made by nailing a handle to a cigar box. You can identify the contents of each box by marking on a strip of masking tape stuck on its lid.—*John C. Bernath, Butler, Penna.*

Cutting off small bar stock, rods, bolts and heavy wire is as easy as tapping it with a hammer, with this improvised "hardie" on your bench. Salvage a too-short cold chisel and force it, cutting edge up, into a hole drilled in a steel block. Place the stock across the edge of the chisel and tap it with a brass hammer to cut it neatly to the desired length. Notch heavy material on two sides, then break apart by bending.—*H. J. Gerber, Stillwater, Okla.*

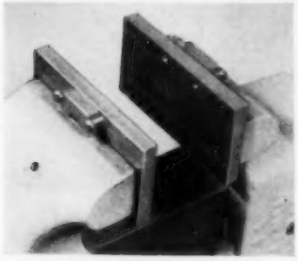
Please turn the page for more shop tips

The POPULAR SCIENCE Shop Notebook

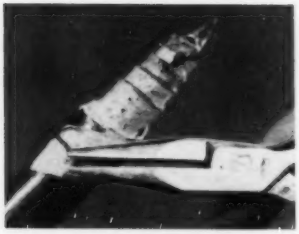


A hollow-ground blade suggests a keen edge on chisels, razors and plane irons. But it's fine on a *screwdriver* blade, too. Ground hollow on both its normally tapered sides by holding it flat against the curved edge of a grinding wheel, the blade will bite into screw heads with a non-slip grip.

Loose, flaking paint can be removed easily with a scraper made by tacking a piece of wire screen to a block of wood. The screen outlasts sandpaper, especially during the rough-scraping process when sandpaper loads up and loses its ability to cut. If the screen clogs, clear it by rapping the block on its side.—*William Swallow, Brooklyn, N. Y.*



Aluminum "soft jaws" can be securely held in place on a vise with magnets. This method eliminates the nuisance of loosening screws to change jaws whenever smooth-finished work must be gripped. Since permanent magnets are notoriously difficult to drill by ordinary methods, use round-head screws spaced close to the ends of the magnets so that the heads overlap them, and clamp them to the aluminum.

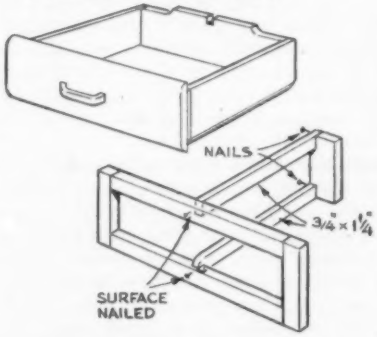


An old ironing board makes a handy work table for the shop. Set it up in the middle of the floor, and you can walk around it while gluing or painting a project that would otherwise occupy most of your bench space.—*Fred C. Stebbins, Kansas City, Mo.*

When soldering in close quarters, you can protect adjacent parts from accidental contact with the hot iron by wrapping all but the point of the copper tip with asbestos strip. The last turn of the wrapping can be held in place with a band of wire twisted tight.—*Ken Murray, Colon, Mich.*

HAVE YOU TRIED THIS?

Ever pull out a drawer too far and have it drop on your toes? In your next cabinet, build a stop at the rear of the drawers to limit the pull-out. Chamfer the lower rear corners so the drawers can be inserted or deliberately removed by tilting them upward. The dodge can be used, too, on existing drawers. Simply glue stop blocks to them.—*R. J. Rempel, Petaluma, Cal.*



Pitfalls to avoid in

Buying a Development House

Before you put cash down on a "package" home, unwrap it and see what's inside. Here's how

By John L. Springer

IF YOU are thinking of buying a new house, you almost surely will look at developments in your area. Chances are that you may buy in one: Experts estimate that three out of five homes now built in the U. S. are in tracts with a dozen or more identical houses.

Most big developers use a glittering new tool—the sample house—to make sales. You see a complete home, beautifully furnished and ready to live in, and you order one to be built like it. It seems an easy way to buy—but don't be fooled:

Actually, buying a house this way involves special problems that you won't find in buying an old house or custom-building a new one.

In an existing house, you see just what you get. You can examine the house itself, streets, schools, shopping districts. When you hire a builder to put up a house for you, the community probably is one you know, and you can decide on the specifications, how to locate the house on the site, and other questions. If you see some-

This is the second of a series of articles. Next month: "Build as Your Own Contractor" tells how you can save money by shopping for bargains in labor and materials instead of doing the work yourself.

Be your own inspector before you sign on the dotted line

There is more to buying in a development than looking at the model house—all prettied up inside and out by the builder to be as attractive as possible. It will pay you to check up on construction, house location, neighborhood. Here are some useful tips that will help you avoid costly pitfalls.

Most model houses are furnished by decorators at a cost of several thousand dollars.

Check on zoning, or you may find a clanking factory as your new next-door neighbor.

Bulldozer, spare those trees! A wooded lot may be stripped unless you squawk first.

thing you don't like during construction, you can pin the builder down.

When you buy from a model home, you can't examine the house *you* will live in—it hasn't been built yet. You merely look over a sample—maybe built more carefully, maybe less. Often the site hasn't been marked out and you see only a plot on the map. You may not even know whether your lot slopes in all directions or is as flat as a pancake. Maybe schools, churches and shops are still to come.

You need a new set of rules to shop for this type of house. Here are basic points compiled after interviews with architects, builders and many buyers of development houses:

Don't let looks deceive you. Most model houses are furnished by professional decorators—sometimes at a cost of many thousands of dollars.

They know all the eye-fooling tricks. To make rooms seem larger, they use wall-to-wall carpet, set up fewer chairs and tables than are needed, make all furniture underscale, use many mirrors.

Ever wonder why many development houses have huge picture windows, or sliding glass doors leading onto patios? A prominent development architect told me why: Builders use big glass areas to bring the outdoors in and make rooms look more spacious.

These decorating tricks are legitimate. You might even want to use them yourself. But don't let them deceive you into thinking you're getting a 25-foot living room, say, when it measures only 20 feet.

Investigate the site thoroughly. Developers often put model houses on main roads, far from the wilderness where your dream home will rise. It may be rocky ground where even a weed won't grow, or swampy soil where you'll have a battle to keep water out of the basement.

Hundreds of families bought Cape Cod houses in a Connecticut town. They moved in and the builder moved out, leaving rock-strewn, unpaved streets behind. It cost each homeowner about a thousand dollars extra to get those streets paved. Before you sign, find out who will install and pay for streets, utility lines, sewers.

Most communities set aside sections for heavy and light industry, stores, apartment houses and one-family homes. You can build in an area zoned for factories, but factories can't build in areas zoned only for housing. Thousands of development buyers are stuck every year through improper zoning. One suburban builder sold 20 houses in a weekend to customers who chose plots overlooking beautiful woods. Soon bulldozers stormed into the woods and a factory was clanging behind the back yards day and night.

Investigate the site. Otherwise you may find your house put up out in the wilderness.

Visit a house under construction—check on the insulation, quality of framing lumber.

Poke around in the cellar or attic of a model house to check on construction details.

Before you sign anything, hire a lawyer who is familiar with development housing.

You often see a model house on a spacious corner. But other houses—including yours—may go on postage-stamp lots hemmed in on all sides. It's a good idea to take measurements and determine how much space there will be between houses.

Check too on how your house will be placed on the lot. The world's most glamorous house may lose its attractiveness if it is poorly placed.

The likelihood that soil conditions will vary on a tract also creates problems. In a New York suburb, a model house was built on sandy soil with good drainage. The builder didn't waterproof the foundation as the cellar kept dry naturally. Other houses, built to identical specifications, went on clay soil with poor drainage. Instead of dry cellars, buyers have year-round wading pools.

Ask questions about what you can't see. When you examine a model house, the insulation is hidden by the finished walls and ceilings. The builder may claim he provides "full insulation." He could mean anything from thin aluminum-covered paper to thick batts of mineral wool. Demand specifications. A well-insulated house should have at least two inches of mineral wool or its equivalent in walls; four inches or its equivalent in ceilings.

It's the same with floors. Some builders advertise that they provide oak flooring—then cover the floor so that prospects see only wall-to-wall carpeting. Sure, you'll get oak. But it may be an inferior grade, discolored and knotted.

You may see lovely wallpaper jobs in model houses. Even some ceilings are papered. A new decorating trend? Maybe. But paper also conveniently covers defects in plaster or plasterboard. You'd better question how many coats of plaster you're getting (quality jobs have three) or how thick the gypsum wallboard is (recommended for walls: one-half inch).

Make sure of costs. There's often no resemblance between advertised price and what it costs to get the house you want. Don't blame the builder: It's often hard to draw a line between the cost of the house and related costs. Some builders include land, streets, sewers, mortgage-closing costs in the price. Others list some or all as extras.

Most model-house kitchens are furnished with refrigerators, ranges, dishwashers, exhaust fans. Sometimes they are standard equipment, sometimes not.

Decorating almost always involves extras. Some builders do no decorating at the standard price. Others give you a choice of a few shades of paint, and soak you $40 a room for anything else. On Long Island, I saw a $12,000 sample

house decorated with $6-a-roll wallpapers. Buyers could choose 60-cent paper; anything better cost additional.

You should also be prepared to spend extra for landscaping. A builder may spend thousands on shrubs and lawns for the model house but less than a hundred dollars for other houses. In fact, some make it as hard as possible for homeowners to landscape properly. Two developers bought a golf course in Westchester County, N. Y., and sent bulldozers through to push the rich topsoil aside. They sold the topsoil and made enough money to pay for the land. Five years later, owners are struggling to get good lawns out of the hard clay.

Millions of development-house buyers now pay taxes double, even triple, what they expected. Here's what often happens: A developer moves into a rural area. Low tax rates lure prospects, most of them with growing families. Suddenly hundreds of children must be educated. New schools are built—and taxes zoom.

Take nothing for granted. "To avoid future disagreements, both parties should clearly understand in advance exactly what is to go into the house and what post-sale services are to be performed by the builder," say spokesmen of the National Association of Home Builders.

A New Jersey development advertised houses with expansion attics. When buyers tried to add rooms later, the building inspector stopped them—the floor joists were strong enough for storage, not for rooms. On some other "expansion attics," unless you spend a few thousand dollars to raise the roof, you will be stuck with ceilings too low for comfort.

In one development, prospects saw a model house with an attached garage, available as an extra. Some buyers passed up the garage, intending to add it later. Too late, they discovered that not enough space was left alongside the house for the garage and the clearance to the lot line required by the local code.

Plan to add rooms later? Don't take for granted that the heating plant will be large enough. Most systems will heat existing rooms of a house, but few builders worry about future demands. You're wiser to check and, if necessary, get a bigger furnace at the beginning.

Heavily wooded lots are often chosen because buyers presume the trees will be there when the house is built. But unless they get the builder to agree—in writing—to save trees, they may find a bare lot.

Snoop intelligently. Poke around in the unfinished cellar or attic of a model house: You'll see features you might otherwise miss. You probably can check on the wiring: Armored electric cable is generally more expensive than plastic-covered. Rough subflooring laid diagonally to floor joists costs more but is considered better because it permits finished flooring to be nailed in either direction. In the attic, you can examine carpentry details hidden behind walls downstairs.

Hire a lawyer familiar with development housing before you sign anything. Tell him everything you expect and let him settle arguments with the builder.

Generally the builder makes all mortgage arrangements. If the bank okays you as a credit risk and you sign a contract, you're tied up permanently. Maybe you don't want the mortgage offered and want to pay off in 10 years, instead of 20 or 30, to reduce total interest charges. Your lawyer can make sure that the contract won't impose a stiff penalty if you refuse the mortgage offered.

He can help in other ways. Say that you've made a deal on your old house and must move out in three months. He can insert a clause in the contract stating that the new house will be ready—or the builder will put you up in a hotel.

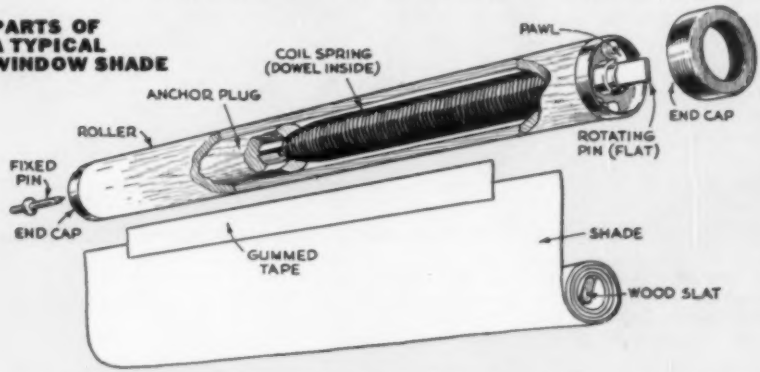
Most developers are honest. They want to do the right thing, to make and keep customers satisfied. Only the rare one would intentionally deceive you. Nevertheless, thousands of details go into a house. You'll overlook some things, mistakenly expect to get others or have an honest difference of opinion over them. A clear, comprehensive contract is the best way to take advantage of the housing values that modern assembly-line developments offer. END

Having a tug of war with a window shade, or have you already lost the battle to one that came down and hit you on the head? For tactical information on the care and taming of window shades, tear out this sheet and add it to your POPULAR SCIENCE Fix-It File.

Next Month: Patching stucco.

Popular Science Fix-It File

PARTS OF A TYPICAL WINDOW SHADE



HOW A WINDOW SHADE WORKS: A spring inside roller raises shade when pawls are released by the centrifugal force of rotation. When you stop the shade's travel, pawls drop into position to lock the roller. Fabric attaches with gummed tape, tacks or staples.

When a shade won't roll up . . .

TAKE IT DOWN and roll fabric up by hand. Put it back on the brackets and try it. If too tight, remove it and unroll a few turns of the fabric.

CHECK THE PAWLS to see if they are stuck. Two types are shown above; both work easier if lubed occasionally with graphite or light oil.

IF SPRING IS BROKEN, best cure is a new roller. But an emergency repair *can* be made if break is near end by resetting remaining spring.

If roller is wobbly or falls out of brackets . . .

BENT PIN sometimes causes roller to wobble. Straighten it with pliers or replace it with a nail of about the same diameter and length.

EXTEND PIN or replace it with a longer nail to make it fit between the brackets. Shim the pin as needed with washers or several small nuts.

USE SCREWS rather than nails to fasten loose brackets to outside of a window casing. Reset brackets if necessary to fit the roller's length.

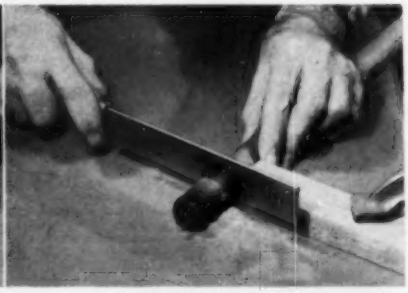
If the fabric is torn . . .

REPLACE IT with a new, unmounted shade. These are inexpensive and come with a gummed flap that makes them easy to attach to the old roller. To determine right width to buy, measure *inside* the roller end caps.

CONCEAL A TEAR or a dirty spot at the center of the slat with a slip-on plastic shade pull that also replaces a torn-out cord pull. The pull is transparent, so cover the spot with a matching cloth tape before installing it.

How to shorten a roller

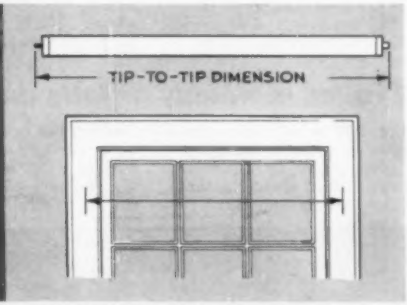
TO SWITCH SHADES to smaller windows in different rooms, remove the fabric and cut the fixed-pin end of roller (see measuring instructions below). Score a cutting line at the new length by running a knife over roller.



SAW ROLLER END square to prevent wobble and install end cap and pin. Trim sides of shade with razor and straightedge to fit between end caps on shortened roller. Fasten shade to roller with tacks or cellulose tape.

How to measure for new shades

FOR SHADE INSIDE CASING, measure the opening and subtract ⅛″ to get the *tip-to-tip* length of the roller (including the end pins). Measure length of opening and add 8″ to determine the required shade length.



IF INSTALLED OUTSIDE CASING, measure opening and add 3″ for overlap at each side. Measurements for outside-casing installation are not too critical as brackets can be placed so that they fit roller length precisely.

POPULAR SCIENCE
REFERENCE LIBRARY
No. 7

Things to do

Before You Paint Your House

Where to find the facts

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Foreword

THERE'S more to putting a coat of paint on your house than just swinging a brush. How economical, professional looking and durable the finished job will be depends largely upon good planning and your choice of the right paints, brushes and miscellaneous materials. Most important—it will depend on the care you take in preparing all the house surfaces for a firm bond. Doing this right can add years to the life of a paint job.

This booklet will tell you how to plan the job, how to assemble the materials, how to do all the little preparatory jobs that should come before you dip brush into paint. Make use of the hard-core information on these pages and the new paint will add deep and enduring beauty to your home.

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s the job really needed?

on't be misled by appearance. If the utside of your house looks stained r dirty, it doesn't necessarily need reainting. Too much paint can be almost as bad as too little—the build-up may become heavy enough to pull way from wall surfaces of its own eight.

Remember that modern paints are esigned to wear down by a slow chalking process at the surface. Ideally, the ain is supposed to wash away this halkiness, carrying dirt with it and eaving a fresh, clean surface. Unfortunately, this doesn't always work. Some areas wear unevenly. Others, exposed to little rain, do not wash clean. Wind-blown dirt, mildew and rusting gutters and screens may also mar a paint job before its time is really up. In many cases all that's needed is a good hard scrubbing with a stiff brush, a household detergent and water.

If washing won't remove the stains, painting may be advisable for appearance's sake, but still not necessary for surface protection. The real need comes when the old paint shows signs of cracking, blistering or peeling. Exposed to the most sunlight, the south side of your house usually takes the worst beating. That goes double for horizontal surfaces like window sills. Keep an eye on them; they'll give you your first danger signals about the condition of the rest of the house exterior.

One coat or two?

ood-quality modern house paints are nuch more opaque than those made ears ago. As a result, a two-coat job vill generally cover as well as the hree-coat jobs once used, and one coat nay do the trick where two coats were ormerly needed. As a rule-of-thumb, ou can figure that a white house needs nly one coat if no more than four or ive years have elapsed since the last aint job. After six or seven years, two oats will probably be needed. Dark ouses which are to be repainted with similar color generally need only one coat every six years. These figures are based on the assumption that good-quality paints are properly applied to surfaces that have been carefully prepared.

If your house needs a two-coat job, try to use a primer and a finish coat made by the same manufacturer, because the undercoater is usually formulated for a particular finish. A few manufacturers recommend using the same paint for both coats, but give specific instructions for thinning each. Be sure to read the labels carefully.

Choosing the right paints

rim paints. Resembling a glossy namel in appearance, trim paints are ree-flowing and dry quickly and hard. Besides black and white, they come in bright colors which are not as likely to fade as other types of exterior paints. They are your best bet for doors, windows, shutters and other outside trim.

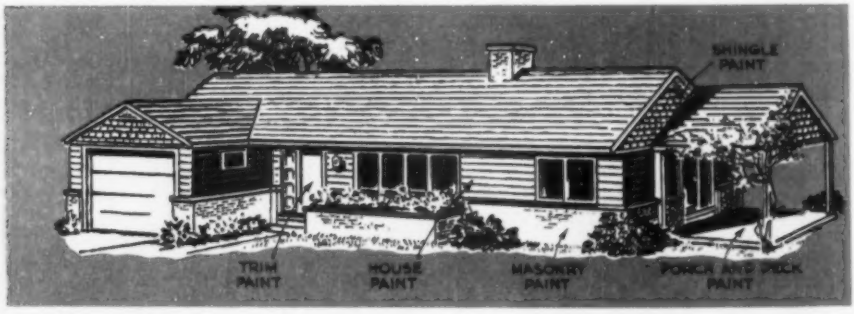
But don't use them on the body of your house. Because they dry hard and do not chalk like other exterior paints, they are more likely to crack or blister when applied to large areas. The single exception is a protected wall (one under wide eaves, or a porch roof). Here, where rain provides no washing action, a non-chalking paint may be easier to keep clean.

House paints. These are the linseed-oil-based paints you will use if your house has wood siding. They form a softer, slower-drying film than trim paints, and wear down by gradual chalking. Steer clear of the so-called "one-coat" varieties if the lower areas of your house are of dark-colored brick or shingles—these high-hiding paints chalk heavily and may cause objectionable stains.

Masonry paints. Here you will be faced with a wide variety. Some masonry paints are cement-based powders which must be mixed with water immediately before using. Others are ready-mixed formulations based on linseed oil, alkyd resins, or any one of half a dozen latexes. (The last-named type is water-thinned.) All masonry paints are designed to withstand the free alkalies that are frequently found in masonry walls; but under certain other conditions (exposure to extreme sunlight, a great deal of moisture, etc.) one type may be best for your walls.

Shingle paints and stains. Again you will find a wide choice. Stains impart color and preserve the wood, but they are thin-bodied and have little hiding power. Shingle paints, which are opaque and dry to a dull finish, provide what is known as a "breathing" film. This means that they allow trapped moisture to escape from behind shingles, and have less tendency to blister than ordinary paints. If you already have a stain on your shingles you can apply either another coat of stain or a paint. But if your shingles are painted you must repaint them.

Porch and deck paints. These are hard-drying, flexible enamels that give a waterproof finish and stand up well under scraping and scuffing. Some are made specifically for wood, some for concrete, and others for both materials. Many of the concrete floor enamels require a neutralizing rinse of zinc sulfate or muriatic (hydrochloric) acid solution before they are applied. Ask your dealer—and study the labels.



Average covering power of paints

TYPE OF PAINT	SQUARE FEET PER GALLON	
	1ST COAT*	2ND COAT**
Oil-based primer on wood	450	...
Oil-based house paints on wood siding	500	600
Varnish-based trim paints	600	750
Oil- or alkyd-based shingle paints		
wood shingles	250	350
asbestos shingles	200	300
Shingle stains on wood shingles	100	150
Porch and deck paints	300	400
Ready-mixed masonry paints on stucco or brick	200	300
Powdered cement-based masonry paints	100	150
Black asphaltum roof coating	80	...

Note: Coverage figures can vary, depending upon porosity of individual surfaces and materials, and upon manufacturers' differences in formulation.

* Figures assume that surface is either raw (unpainted), or fully weathered down.

**Figures assume that surface has been painted recently.

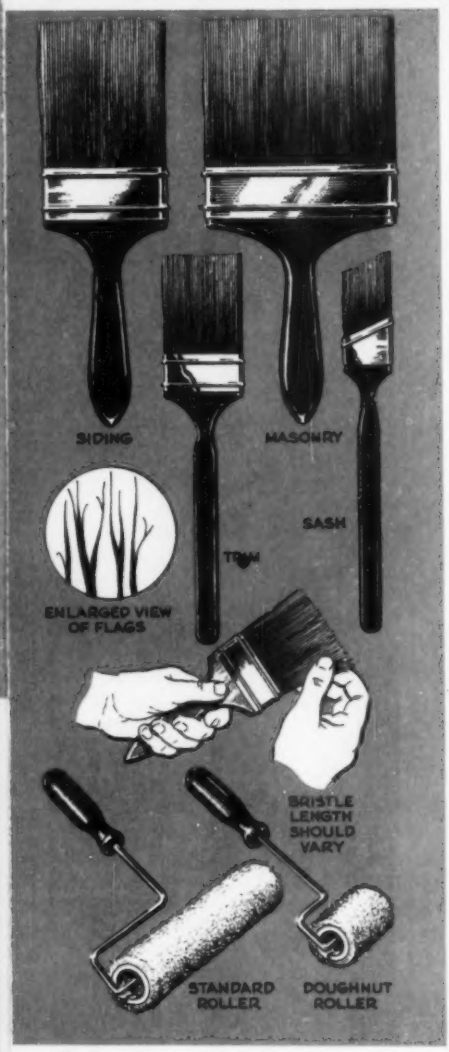
How much paint?

The amount of coverage you can get from each gallon of paint will depend upon how you thin it, how evenly you brush it on, and how porous the surface is. It will also vary to some extent with different brands. However, the chart above will help you approximate your needs. Notice that in every case the second coat will go farther than the first. This is due to reduced absorption. The first coat seals the surface.

Ignore all windows and doors with areas of less than 100 square feet when figuring wall surfaces. Any small saving here will be canceled out by normal wastage when you "cut in" around such openings.

For a rough estimate of the amount of trim paint you'll need, figure on one gallon for every six gallons required for the body of the house. Generally one gallon will cover between 15 and 20 average-size windows (one coat).

Brush-buying tips



You'll need three brushes at least, and possibly four, for outside house painting. The three basic types are a 4″ or 4½″ brush for siding and shingles, a 2½″ or 3″ trim brush, and a 1½″ or 2″ angular sash brush for cutting in around window panes. For stucco or other masonry surfaces you'll do best with a 5″ or 6″ brush.

For long wear and thoroughly professional results it will pay you to buy the best brushes you can afford. Good ones are available with either nylon or natural hog bristles. Because nylon is almost certain to hold up longer, brushes of this type are preferable if you have large areas of rough masonry to paint.

Regardless of the bristle, the brush should feel springy to the touch, have a high percentage of "flags" at the tip, and provide plenty of bristles of different lengths so that additional flagged tips are exposed as the original ones wear down.

Where to use rollers

Rollers will speed up some parts of the job. You'll find them particularly suitable for spreading paint on wide, plywood-covered cornices and overhangs, for flat siding, fences, cement blocks, stucco, and porch and patio floors.

For siding you'll need two rollers—a narrow, doughnut-shaped one to work paint onto the edges of each board, and a conventional one for faces. For wire fences and very rough masonry, use a roller with a deep pile or nap.

Burning. On some parts of your house

extensive use, the safest way to remove

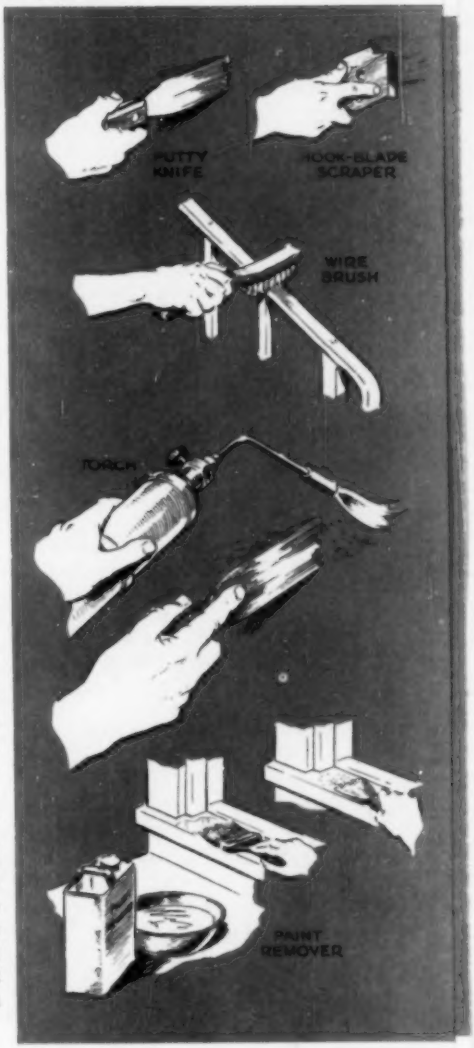
Removing old paint

Scraping and sanding. On wood, use a stiff putty knife and a hook-type hand scraper to remove all loose, cracking and peeling paint. The putty knife is best for pushing off those sections that have practically freed themselves. Follow up with the scraper on stubborn sections where more pressure is required. Work back to areas where the paint film is still sound and adhering tightly.

As each rough or blistered spot is scraped bare, use medium-grit sandpaper to feather off the edges so they won't show through as ridges on the finished job. If you are sanding by hand, a holder or sanding block will make the work easier. Where extensive sanding is needed, it may pay you to rent or buy a portable belt sander. You can also chuck a sanding disk in an electric drill, but remember to handle any power sander with a light touch. Too much pressure will mar the surface of the wood.

Pay particular attention to window sills and the other trim around your doors and windows. In addition to removing scaled paint you should dull down any glossy areas by sanding or scraping. Coarse steel wool may be handiest in some corners, as well as on moldings and other concave or convex surfaces.

On stucco, shingles and ironwork, a wire brush is the right tool to use. A wire wheel chucked in an electric drill is also handy for stubborn or difficult-to-get-at sections. After removing loose paint from ironwork, use steel wool to rub off any rust. Emery cloth is good for rubbing the metal clean where rust accumulations are very light, and in any case for final polishing.



Burning. On some parts of your house you may find paint so badly cracked and alligatored that the only practical solution is to remove the old paint completely. One way to do it is by softening the paint with a torch. This goes fast, after you get the knack, but it can also be dangerous. Precautions:

1. Don't burn paint off on a windy day. The flame will be hard to control and the danger of starting a fire with flying sparks is greatly increased.

2. Don't point the flame at right angles to the surface. Instead, aim it slightly ahead of your scraper. *Never point the flame upward*—the natural updraft of air will transmit too much heat to the area, and you will almost certainly set fire to the paint and the wood beneath it.

3. Always keep the flame moving. The heat is only supposed to soften and blister the paint, not to burn it so completely that the wood underneath is scorched.

4. Use a long-handled putty knife to keep your fingers away from the flame.

5. *Most important*—keep a bucket of water or a fire extinguisher within easy reach, and when you finish any area, examine it for signs of sparks that may still be smoldering.

Chemical paint remover. Although slower than burning, and too costly for extensive use, the safest way to remove badly cracked or alligatored paint is with a non-flammable chemical product made for this purpose. Buy the thick liquid or semi-paste kind to hold running and dripping to a minimum.

Smear the remover on liberally with the flat of an old brush and allow it to soak in for five to 10 minutes. After the old paint has softened and wrinkled up, scrape it off with a wide putty knife.

Where paint accumulations are very heavy you may need more than one application. Consult the label on the can for information about the kind of after-rinse needed.

On exposed brickwork you may find a sort of white, powdery dust that must be removed before painting. To get rid of this efflorescence, wash the surface down with a dilute solution of commercial muriatic acid, obtainable at most paint stores.

Mix one part muriatic acid with two parts of water in a china, glass or wooden container (not metal). Pour the acid into the water—never the water into the acid. Wear gloves and goggles to protect yourself while you rub the solution on the masonry with an ordinary bristle scrub brush. Let it soak in for several minutes, then hose it off thoroughly with a spray of clean water.

Minor repairs

Renail loose boards and replace rotted ones, along with cracked or missing shingles before painting. Countersink nails and fill the holes over them with putty.

If cracks in stucco walls are over one-eighth of an inch wide, don't attempt to seal them with calking compound. Instead, use a cold chisel and hammer to chip them out so they are widest at the bottom. Remove all of the loose material with a brush and wet the area down thoroughly with clean water. Then pack the crack tightly with freshly mixed patching cement, using a small pointed trowel.

What you need

Shutters and screens

Calking and puttying

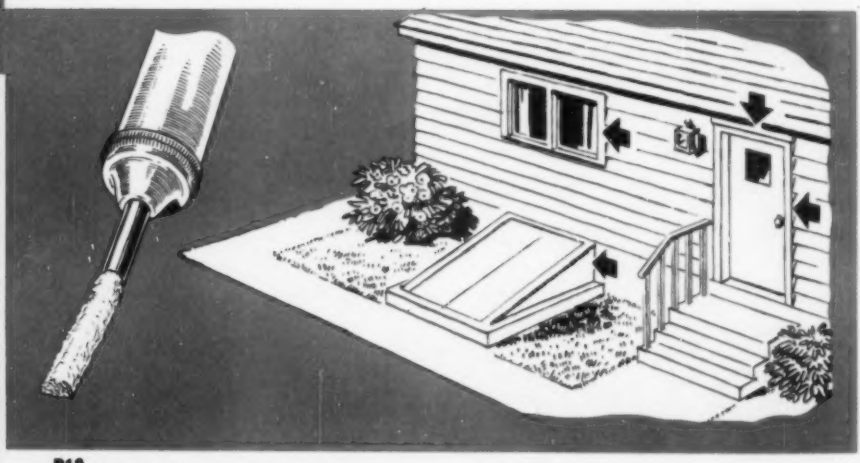
Beware of water that works its way behind the surface. It's the biggest enemy of any outside paint job. This trapped moisture almost inevitably causes blistering, cracking and peeling. A calking gun is your best defense against such damage. Use it at all open joints. These include the ones around window and door frames, and where vertical window trim meets horizontal sills, porch floors butt against house walls, wood or metal frames are set into masonry walls, and metal flashings join masonry or roof coverings. Use calking, too, to seal cracks in wood siding or in stucco—and for sealing off seams where two types of material meet.

Calking comes in three shades: white, gray and black. Use white if you have white trim, gray for colored trim (in this case you paint over it), and black around roof flashings.

Before applying new calking, scrape off any old compound that has cracked or loosened. Then dust the joints out thoroughly with a stiff brush.

If you're using a gun, learn to move the tip along slowly while maintaining even pressure on the trigger. Hold the gun at a slight angle to the surface, and at the end of each trigger stroke release your grip and start a new stroke with the same even pressure, keeping the gun moving all the time. When properly applied, the bead should be convex at the surface (not pressed in).

Where window sash require puttying, clean out the rabbets with a stiff putty knife or wood chisel. After brushing away loose dust and dirt, give the rabbets a coat of linseed oil or an outside primer. When this dries, roll the fresh putty into long ribbons about as big around as a pencil. Press them into place and, holding the putty knife at an angle, drag it along the sash to smooth the putty to an even bevel.



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Shutters and screens

emovable shutters, storm sash and reens should be taken down and ored, either in your garage, basee-ent, or some other convenient shelred spot. There, they'll be out of our way when you're working on the ain house areas, and they can be laid flat for painting when you get to them.

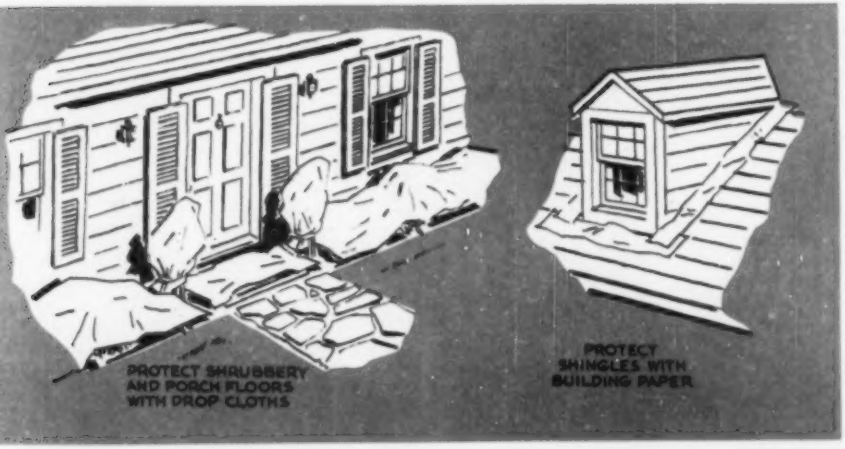
Save this job for times when bad weather keeps you from working on the house itself. If you are really ambitious, you can extend your day by painting a few of them after it gets too dark to see outside.

Spatter protection

ress for exterior painting—messy best—by wearing old clothes, inuding a cap or hat. Protect shrubery close to the house, walks and atios from accidental spatter by covring them with drop cloths. All paint ores sell inexpensive paper or plastic nes that serve the purpose well. Use rips of cloth tied to stakes to keep hrubbery away from your house walls. his precaution will not only protect he plants but keep their branches from cratching up the wet paint.

Spilled paint is almost impossible to remove from roof shingles. So when working around dormers, protect nearby roof areas with strips of building paper held in place with stapling or tacking. These strips should be narrow enough to let you reach the sides of the dormers without having to stand on the paper.

Stay off the paper; it may slip, and its surface is too smooth to provide a safe footing on any roof with an average pitch.



P.S. EXTRA: YOUR TEAR-OUT BOOKLET NO. 7

To remove this booklet, place your left hand on the facing magazine page, grasp the booklet with your right, and pull it gently away.

After reading, file for future reference. You'll find it valuable on many home jobs.

March 1958
POPULAR SCIENCE

How to Banish Hi-Fi Noise and Hum

The causes are often obscure and baffle even the experts. Here are tips on what to do

By Eugene F. Coriell

OF ALL the gremlins that bedevil a home music system, hum and noise are the worst. Hum is a continuous, low-pitched tone, caused when 60-cycle AC power gets into the audio circuits. Noise is any other disturbance—sharp crackling sounds, clicks, hisses, howls.

You can hunt down hum and noise yourself and pocket some easy money—the cash you would otherwise have to pay for commercial servicing.

Locating the trouble is the first step. If you hear hum or noise only when one of the sound sources is in use—the record player or the radio tuner—the trouble is in that unit. If the hum or noise can be heard with both player and tuner, the trouble is in one or more elements associated with both of them—the amplifiers, the speaker, or the external cabling or wiring between units.

External wiring is the first place to look for trouble. AC cables sometimes cause hum by being placed too close to the audio cables. Don't let your wife talk you into tying the hum-packed AC cords into a bundle with the other cables just because they will look neater that way. The neatness will go up all right, but so will the hum.

Move each audio-cable plug carefully in its chassis socket and note whether the hum or noise stops while the music keeps playing. If so, there is probably

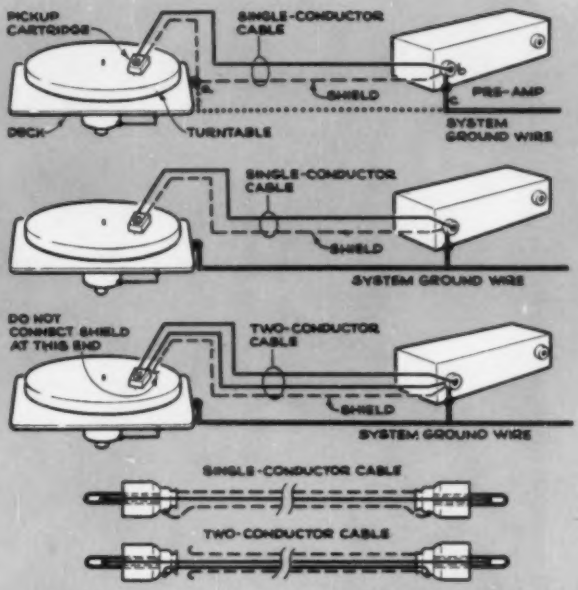
Ground loops: What they are, how they happen . . .

USUAL GROUNDING ARRANGEMENT has cable shield grounding turntable deck. Separate ground (dotted line) would produce a ground loop (abca)—a closed circuit in which any nearby hum field could induce hum voltages.

A BETTER WAY is to insulate cable shield from deck and connect the deck directly to the ground wire. The cable shield still carries the audio current, but there is less chance of an accidental ground loop.

BEST ARRANGEMENT uses two-conductor shielded cable. The cable shield carries neither the audio current nor the deck ground connection. Shield is grounded at the pre-amp, but insulated from the pickup.

SINGLE-CONDUCTOR CABLES are standard. You can make the two-conductor type. Connect audio ground wire and shield to shell of one plug; ground wire only to the shell of the other. The former plugs into the pre-amp.



a loose plug or socket contact, or a loose connection to such contacts. Also gently flex the cables themselves. Any sharp crackling sounds that result indicate partial breaks in the inner conductor or in the shielding braid.

To ground or not to ground. To reduce noise and hum in a hi-fi system, the usual recommendation is to connect the parts to a ground wire that runs to a water pipe, that is, an earth ground. The idea is a good one, but don't make the connections on blind faith that this will always reduce hum.

Sometimes hum will actually increase. When you connect various components, you may unwittingly create two or more ground connections between the different chassis—the shielding braid on the audio cables, power cables, the external ground wire, etc. These form a closed loop—a "ground loop"—that acts as a pickup coil in which any nearby hum fields induce hum voltages.

You may also have a hidden connection to earth ground through a condenser connected from the power cord to the chassis. Since your power line is grounded, there is likely to be a tiny hum voltage that will be amplified by a high-gain amplifier, between this ground point and your water-pipe ground.

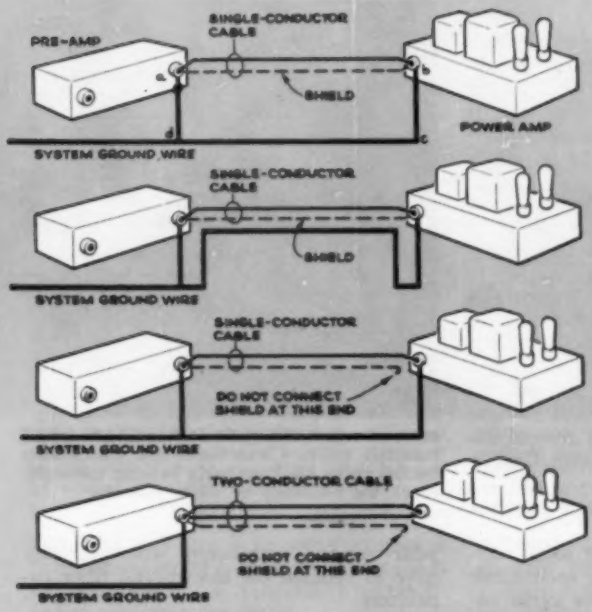
So approach your grounding system with an open mind. Make trial connections with the volume turned up so you can hear any change in hum level. Try grounding each component separately as well as in combination. Every hi-fi installation is different, so you will have to experiment to find the best arrangement.

Treat the amplifier as a unit even if the pre-amp, power amplifier and power supply are physically separate. Try the old dodge of reversing the AC plug in the wall socket. If there is more than one AC cord, try all combinations.

Then check all control settings:

- Is the level control on an unused channel wide open?
- Are treble and bass inadvertently set at either extreme of their range?
- Are the record player and the tuner

. . . and how you can prevent them



HUM OFTEN ARISES from a ground loop formed in connecting the pre-amp to the power amplifier. The cable shield makes one ground connection; a closed loop (abcd) results from completing any other ground connection.

CLOSED LOOP acts as a pick-up coil in which any nearby AC hum fields will induce a hum voltage. You will get less hum pickup if area of loop is reduced by running ground wire close to audio cable as shown at left.

AVOID CREATING a ground loop if you can. Break the connection of the shielding to the shell of the plug at the power amplifier. The low side of the audio circuit will be taken care of by the system ground wire.

A TWO-CONDUCTOR CABLE with the shield connected only to the pre-amp chassis is the best arrangement. Power amplifier is grounded through low side of audio circuit. The pre-amp connects to the system ground.

feeding enough signal to the amplifier?

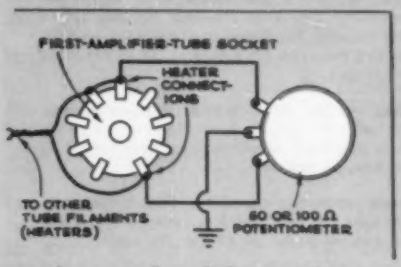
• Is the record equalizer in the wrong position? This can cause excessive hiss.

Many modern amplifiers have a hum-balancing control. If yours doesn't, see the box below for instructions on how to add one. Adjust the hum-balancing control for minimum hum with the input selector on "magnetic phono," the volume control wide open, and bass control turned to maximum bass.

Look around inside the amplifier for missing or poorly seated shields on glass tubes. Tap each tube with a pencil and

Add a hum-balancing control

MANY MODERN AMPLIFIERS have a hum-balancing control. If yours doesn't, in most cases you can easily add one. Buy a two-watt, 50- or 100-ohm potentiometer and mount it on the chassis near the input tube. If one side of the filament (heater) is grounded, you will have to disconnect the ground at each tube socket and run a wire back to the transformer. In most hi-fi amplifiers, the filaments will be parallel-wired with the center tap of the filament winding on the transformer grounded. Disconnect the center-tap ground. Now connect the outside lugs on the potentiometer to the two filament lugs on the input tube. Connect the center lug of the potentiometer to chassis ground. Recheck the complete filament circuit to be sure that the only ground is through the potentiometer.



note whether noise or hum changes in steadiness or intensity. If so, the tube is faulty. Replace it.

If tapping duplicates a ringing or howling noise heard occasionally on certain musical notes, the speaker is causing some elements in the tube to vibrate. If a new tube isn't enough to cure the trouble, try wrapping a few turns of solder tightly around it.

Substitute new tubes, one at a time, for the tubes in the amplifier and preamp. Leave the new ones in those positions that yield improvement.

Tighten the clamping screws that hold the power transformer together. Loose laminations in the core may vibrate the first-stage tubes into production of hum. In case of severe vibration, mount the transformer and/or the first-stage-tube socket on rubber washers and ground the transformer case to chassis with flexible braid.

Clean noisy volume and tone controls with contact cleaning fluid.

Look under the chassis for loose connections, bare wires touching each other or the chassis, suspicious solder joints, especially those that bond shielding braids to chassis. If there is no bottom plate, make one from sheet metal, or set the amplifier on such a sheet and bond it to the system ground wire.

If there is still hum in the amplifier,

How to Order Popular Science Hi-Fi Test Records

Test with "True Sounds of Musical Tones": *The new Popular Science Hi-Fi Test Record No. 2 uses instrumental sounds. Special price to PS readers: $3.50 for one, $5 for two.*

Test with sine-wave frequencies: *The popular Hi-Fi Test Record No. 1 is again available at the special price of $3.50 for one, $5 for two.*

Save money on the combination: *You can buy both (a No. 1 and a No. 2) at the special price of $6 for the pair.*

To order: *Send cash, check or money order to Magazine Services, Inc., Dept. R358, 104 E. 26th St., New York 10, N. Y. Stores that sell Urania records also have them.*

Hushing other sources of

REMOVE TURNTABLE PLATFORM to find causes of turntable noises. Clean inside rim. Check idler for flat spots, lubricate main bearing sparingly, check the resiliency of motor mounts.

your service technician will probably have to replace the electrolytic filter capacitors.

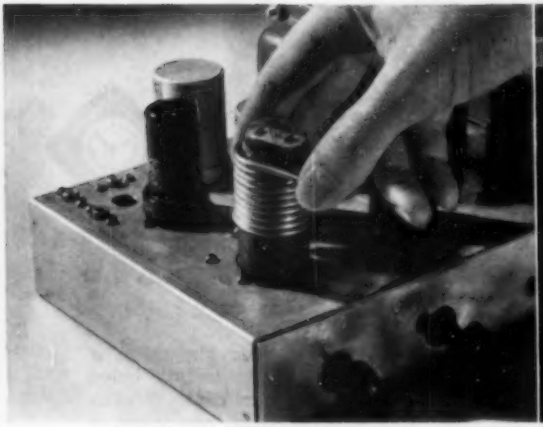
What about the loudspeaker? The cone may be torn, with resulting rattles. If the puncture is small, it can be repaired with masking tape. Large tears require replacement of the cone.

Try pressing lightly against the cone near the center and note if the noise stops. If so, the voice coil is rubbing against the surrounding magnet. This requires centering of the cone; and this, like cone replacement, is a job for the professional.

Loose joints and vibrating panels often cause speaker noise, too. Or sometimes a bass-reflex cabinet, especially a homemade one, reinforces the otherwise unobtrusive 60- or 120-cycle hum frequencies because the cabinet has a resonant peak at these frequencies.

Try blocking off the port completely with a book or plywood. If this reduces the hum, your enclosure is probably peaked at one of these frequencies. The remedy is to change the resonant frequency slightly by tuning the port—that is, by changing its area. Sometimes a few thicknesses of cloth tacked over the port makes an adequate fix.

Next consider your record player. If it turns out to be the source of noise or



TUBES MAY BECOME MICROPHONIC and cause vibrations from the speaker or other source to be amplified. If a tube rings when lightly tapped, try wrapping it tightly with solder.

NOISY CONTROLS can be quieted with contact cleaning fluid. Let it run down the shaft from outside the chassis, or, better, squirt it into an opening in the control cover.

hum, the first step is to see if rumble is being mistaken for hum. Rumble is caused by roughness in the turntable drive mechanism vibrating the stylus.

Here's a quick check for rumble: If you can hear the disturbance while playing the few silent grooves at the beginning of a recording—but not when you lift the pickup from the disc—it's rumble. The cause? Look for dirty, out-of-round or misaligned drive wheels and idlers; dirty drive surface inside the turntable rim; table assembly not floating freely on its springs; dry motor bearings; rubber motor mountings dried out or squeezed solid by bolts drawn up too tight.

Rubber mats that are sold to go on the table under the disc are some help. New idlers are cheap and easy to install.

If the trouble is not rumble, check the following hum and noise possibilities:

- Cartridge leads too close to motor wiring.
- Poor shield connection to cartridge case, deck or pre-amplifier chassis.
- Loose or broken grounding bond between motor frame and deck.
- Pickup affected by motor hum field.

With the motor running, try swinging the arm across the table. If the hum gets louder when the pickup is over the turntable, you are getting hum from the motor. If yours is a separate tone arm, try different mounting locations. On a record changer, the fix is new equipment.

If the complaint is noise, look for loose connections on motor, switch and cartridge, loose or defective cartridge, and worn, chipped or wrong-type stylus. Another thought here: Could the noise be from dirty records?

The tuner is subject to the same hum and noise problems as the amplifier. Occasionally the tuner will have "tunable hum"—so-called because it is heard only when tuned to a station. One cause of this is heater-to-cathode leakage in an RF, converter, or oscillator tube. Another cause is a defective line filter capacitor between one or both sides of the AC line and chassis.

Tuners sometimes create a sharp crackling noise when the tuning knob is turned. This is due to dust between the plates of the tuning capacitor. Blow out the dust or clean the spaces between the plates with a pipe cleaner.

Don't expect to reduce hum so you can't hear it when your ear is right up next to the speaker. But you should not be aware of hum at four or five feet. If the hum and noise are still objectionable after trying all these remedies, you can be reasonably sure the cause is a defective part that will require the attention of a repairman. END

When the color set checked out okay, it became a case of . . .

The TV Serviceman

By Art Margolis

WHEN the door opened to my ring, there stood a character out of Dickens, short-legged, globular of shape, with an apple face under a thin fringe of white hair. He wore a velvet jacket and a wing-tip collar with a fat-knotted tie. Old-fashioned spectacles straddled the tip of a button nose.

"You're late," he said, snapping open a gold hunter's-case watch on a heavy chain. "Follow me."

We walked down a thickly carpeted hall and I heard it then. Ticking. Growing louder. I saw the cause as we entered a large, high-ceilinged room. Hundreds of clocks filled every available space—globe-shaped clocks, grandfather clocks, banjo and steeple clocks, cuckoo clocks, ship's clocks and clocks in the shape of ships. They were on antique tables, in beautiful cabinets, standing on the floor, hanging on the walls.

"My clock collection," he said in a hushed voice. "They all work." Then he giggled, "Tick-tock, tick-tock . . ."

A color-TV set housed in an elaborately carved cabinet caught my eye. On top stood two porcelain clocks. I went over.

"My Dresdens," he cried in alarm. "Don't touch them. They're very delicate."

Very carefully, I turned on the set. A nice black-and-white picture came on.

"You see?" he said, pointing to the screen. "Black and white."

I checked my watch. "But there's no color program on now," I said.

"There was when I tuned in last night," he protested, "and all I got was black and white. Explain that."

I attached my color-bar generator, a little black box used for testing color when no color is being telecast. Patches of color should have come on. What I got was a faintly tinted black and white. I turned up the color control and on came a bright, clear color display.

"You had the color control off."

"Of course," he said. "I know enough to turn the color control down and tune in a good black-and-white picture before switching on the color. I turned it down just before I called you last night."

"And all you got was black and white," I said wearily.

"Correct, absolutely. And even that was better than the crazy color you're getting from that black box."

"It's not *supposed* to get a color program!" I shouted.

"Temper, temper," he said, waggling a finger. "Better hurry, there should be a color program on any minute now."

I went over the possibilities in my mind. It could be one of those pesky intermittents. Then it might be the antenna. The portable antenna in my truck would check that.

"Be right back," I said.

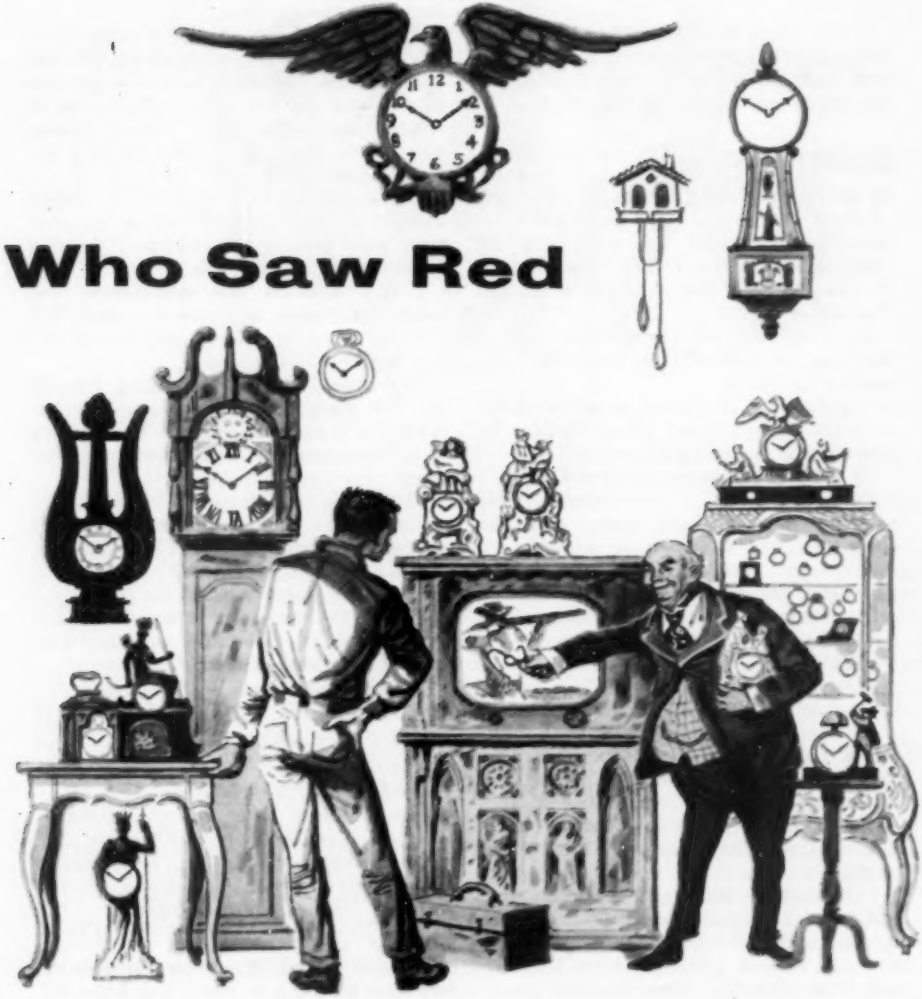
Walking down the front steps I looked up. His antenna was high on a steep-gabled roof. It looked like a job for a helicopter to get up there. I picked up a portable antenna, hoping there wasn't a steeplejack job in my future. I returned to the clockroom to find my character beaming at a beautiful color picture.

"Look," he said smugly. "Color. Better than from that black box of yours."

"A color program came on, that's why."

"Then why didn't I get color last night?" It seemed like a good question,

Who Saw Red



"You see?" he said, pointing to the screen. "Black and white." I checked my watch. "But there's no color program on *now," I said.*

but I was beginning to get suspicious. I picked up a copy of the previous night's newspaper from a chair and thumbed through the back pages.

"Just when did you tune in that color program last night?"

"At 7:30."

I saw red. "Can't you tell time?"

At that he jumped into a ridiculous boxer's stance. "Sir, are you challenging my knowledge of clocks?"

I handed him the newspaper. "Look at the TV listings. The *only* color program on last night was at 9:30, not 7:30. There is nothing wrong with your set!"

"Then why all this jiggery-pokery

of yours with the gadgets, wasting my time?"

I was about to answer when a whirring noise came from overhead, and a little bird popped out of a clock and spoke the words for me: *"Cuckoo, cuckoo."*

Grandma Looks at TV

THE room was ultramodern. The occupant was not. A sweet-faced old lady, tasseled shawl over her shoulders, sat knitting in a Boston rocker by a window. On the floor at her side lay a fat old English bulldog.

As I entered, the dog opened one eye, gave me a baleful look, growled, and nodded off again.

"Come right in, young man," said the little old lady. "Don't mind Diablo; he doesn't like his siesta disturbed."

"I'm the TV repairman, Mrs. Corwin," I introduced myself. "Your grandson tells me there is something wrong with his color set."

"Oh, no," she said. "It's been lovely these last few days. Reminds me of sunsets back on the farm—when I was a little girl." She sighed.

"All right if I look at it?"

"Don't pay us any mind," she said. "But you won't find anything wrong."

I looked at my watch, saw that there was a colorcast on, and tuned in. The color values were confused when the picture came on. I switched to black and white. There I got color, too—varying shades of magenta. "Sunsets," I mumbled to myself.

I checked the picture tube and got the bad news. It was of the three-gun type, as are practically all color-TV tubes—one each for red, green and blue. The red and blue filaments were lit. The green ones were out cold. That explained the mixed-up color picture. And on black and white, the red and blue ones, without the green, added up to magenta.

Inside a "gun," whether color or black and white, are heaters, or filaments, wound inside an oxide-coated tube called a cathode. When the cathode is hot, it fires a stream of electrons at the phosphors on the viewing screen. The difference in a color set is that the viewing screen has phosphors of three different colors, and a separate gun to "excite" the phosphors of its individual color. When any one of the filaments burns out, there goes $175 worth of picture tube.

Having anticipated the trouble from the grandson's description of his TV ailment, I had brought a new color-picture tube along in my truck. Replacing it would take some time. I was debating whether to come back later when I became aware that the *click-click* of the knitting needles had stopped. I looked around and saw that Diablo and his mistress were both sound asleep. I decided to go ahead with the job.

I had finished the installation and made my tuning adjustments when Bill Corwin came in. His grandmother and the dog were still asleep.

"All fixed," I said, switching the set on. The sound of horses' hoofs was followed by a good black-and-white picture of a Western chase. Six-shooters blasted away.

"Heaven's to Betsy! What's that?" squealed Mrs. Corwin, sitting up in her rocker. She looked at the TV. "William, where's that crimson color?"

"Mr. Margolis fixed it," he said.

"Fixed it? Fixed it?" She threw her knitting on the floor and got up. "You know I liked that crimson."

"But Grandmother . . ."

"No buts. You tell that man to put it right back." Shaking a bony finger in his face and scowling at me, "You hear me, William?"

While this was going on I had switched to color. I heard a wheezing and snorting. The bulldog waddled over on his bowed legs and growled at the screen.

"As for that," said Mrs. Corwin, pointing at the TV set, "Diablo doesn't like all those colors."

"I thought dogs couldn't see color," I said.

"Diablo is different," she snapped.

The dog turned his growling attention to me, teeth bared. I got out while I still had the seat of my pants.

Got an old phonograph that embarrasses you when your hi-fi friends come around? Honest labor and good advice can put music into your set that its makers never dreamed of. Technical know-how required: none. Read April Popular Science for full details.

A Woman's Point of View

"OUR fashion show is going to be off color," shrilled a voice over the telephone. "You *must* come over right away. You simply *must*."

My reaction to that startling announcement was stunned silence.

The voice went on about "my dear chap" and a "perfectly awful dilemma," until it calmed down and explained. A women's fashion show from a big department store was about to be sent out over closed-circuit color TV to its branches. This was the manager of our neighborhood branch. His set was misbehaving.

"And in a fashion show," he said desperately, "color is everything."

I agreed to rush over, and in less than 15 minutes I was being escorted into the store's Salon des Femmes by the manager, a dapper little man wearing striped trousers, a formal coat and a worried look.

Three of the store's own tall, slender models were slinking around. I goggled.

"Please ignore our last-minute rehearsal," the manager said. He added coldly, "The television set is at the other end."

The screen showed a dozen or so mannequins walking around a flower-banked stage—a picture all in deep green.

"Did you ever see anything so beastly?" he said. "And we're pushing Chinese red and Dior blue this season—not *green!*"

The models gathered around while I started trouble-shooting. There was a cathode-to-grid short in the green gun, which made it run wide open, blocking the other colors. Shorts of this kind are usually caused by material flaking off the elements and lodging between them, rather than by two parts touching. When tapping the picture tube didn't work, I applied electronic treatment.

"Oooh, look at all those wires he's pulling out," said one of the girls.

I had an attentive audience as I removed the cap of the picture tube and shorted the control grid of the green gun to the chassis. Then I tied the negative side of an 80-microfarad filter condenser to the chassis. Turning the set on, I touched the positive side of the condenser to the handiest source of voltage, No. 11 pin of the tube cap.

When the condenser was filled with electricity, I pulled it off No. 11 pin and touched it to the cathode of the green gun. There was a loud "pop."

"What was that?" asked the manager.

"That was the short clearing up," I told him. "Your show can go on."

As I was putting the wires back together, the lead broke off a pin on the tube cap. Soldering it back was tricky.

"Please hurry," urged the manager. "Customers are beginning to arrive."

"Okay," I said. "Hold this cap for me."

A pair of bare arms encircled my neck from the back. "Let me, darling," said the most luscious of the lovelies, a redhead. She gave me a nice assist.

"That does it," I said, looking up. Then I did a double-take, for there stood my wife, Lea, eyeing daggers at my back.

"Hello, dear," I said. "What are you doing here?"

"I came to *look* at the fashion show," she said icily. "Now I think I'll buy a new dress." END

In planes as in passenger cars, Champions deliver full-firing power.
Above: DC-7 gets set for flight from Idlewild to Paris.

Q. Why do all the world's major airlines use Champion spark plugs?

A. Champions give full-firing power
Put new Champions in your car every 10,000 miles. You'll get an *immediate* boost in horsepower...and save gasoline, too!

World's favorite spark plug on land, on sea, and in the air

CHAMPION

Follow just five important rules and you can easily . . .

Double the Life of Your Battery

1 Avoid overcharging

2 Keep it charged

3 Fill it regularly

4 Prevent vibration

5 Keep case and cables clean

By Ed Fales

YOU can buy a new ($8 to $40) car battery every year. Or you can buy one every three years. What you spend this way depends on how well you treat that little black box under the hood. Ask a group of drivers what ruins most batteries and the majority will tell you lack of water. That's wrong. The really big killer, industry experts say, is overcharging. Next comes undercharging.

A good-quality battery should last you three full years even though it may be warranted for only half that time. (Makers would usually rather play it safe.) Some owners even get four or five years and a life of six is not unknown. But for such performance you must develop an almost fatherly understanding of batteries—and follow the rules.

1 Avoid overcharging

THAT'S the first tip you'd get from a battery engineer. Autopsies by industry experts reveal that overcharging causes 62 percent of all battery failures.

Now and then the voltage regulator starts acting up. In a wrong-headed way it lets the generator go on shooting juice into your battery long after it is fully charged. This raises hob. All that extra energy has to go somewhere. So it heats up the plates and acid, may even warp

the box. It may also warp the positive plates, causing them to short out against the negative plates.

That's not all. The extra juice breaks down the water that is supposed to keep the electrolyte diluted. The water goofs off in bubbles of oxygen and hydrogen. The battery may burp so furiously that acid mist sprays out on the generator and other parts. Valuable lead is loosened from the plates, reducing their area. Result: loss of power. Your cue: immediate attention to the regulator.

How to detect overcharging. If you have a signal light instead of an ammeter on your dashboard, quite a lot of overcharging may take place before you know it. If you do have an ammeter, investigate whenever the needle fails to return to a normal (three- to five-amp) charging rate after 20 minutes of driving.

How's Your Battery?

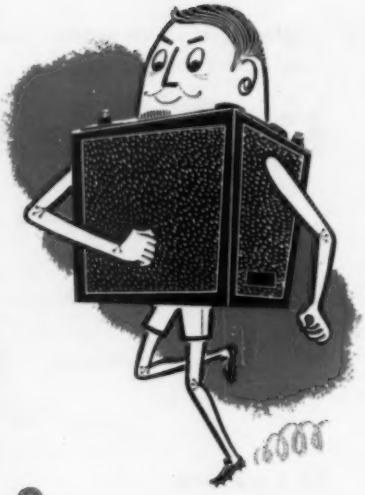
Charge	Specific Gravity*	Voltage**
100% (excellent)	1.260	2.10
75% (good)	1.230	2.07
50% (unsafe)	1.200	2.03
25% (very bad)	1.170	2.00
Discharged	1.110	1.95

*Until recently a battery with a specific gravity of 1.280 was rated as fully charged. Now most makers have lowered the figure to 1.260.

**For accuracy, take voltage reading while battery is not in use and after it has not been charged for at least 16 hours. Reason: A battery with a fresh charge, from garage charger or car generator, holds a deceptive "surface charge."

In any case, an overcharging battery develops a sudden thirst. The cells need more water than usual to replace the water blown away as oxygen and hydrogen. A battery normally should not need more than two ounces (about one hydrometer-full) every month or 1,000 miles.

If just one cell starts on a binge, it's a sign of a short in that cell. Besides buckled plates and piles of debris in the bottom of the battery, short circuits come from lead "whiskers" that extend through holes or splits in separators.



2 Keep the battery charged

WHEN a battery runs down or is used continually without being fully recharged, it develops what the battery men call "sulfation." Now sulfation is the normal chemical process that goes on in the battery when it is delivering current. The sulfuric acid in the electrolyte combines with the active material in the plates to form lead sulfate. When you charge the battery, the process is reversed; the lead sulfate is changed back to metallic lead at the negative plate and lead peroxide at the positive.

But, if the lead sulfate is allowed to remain on the plates for long periods of time because of insufficient or infrequent charging, it changes into larger crystalline masses that clog the pores. You get abnormal sulfation, commonly called, simply, sulfation. This makes it more difficult for the charging current to change the sulfate back and limits the ability of the battery to deliver current.

Causes of undercharging. Undercharging may be caused by (1) a faulty generator, (2) corroded cables that won't let enough charging current into the battery, (3) a faulty regulator. It is also caused by plain ordinary city traffic. In slow traffic, the generator just doesn't run

fast enough to replace the power that's being used.

Here are three things to do if city traffic is at fault: (1) take a long "charging trip" every weekend, (2) have your dealer boost your battery once or twice a month, or (3) install a trickle charger (some cost less than $10) in your garage.

Check a new battery after 500 miles, then every three weeks or 1,000 miles. If a battery tests less than 75-percent charged, have it charged immediately, either by your dealer or by taking a trip.

Fast charge or slow charge? A fast charge is okay as long as your battery doesn't heat up above 125°F. Fast charging used to wreck thousands of batteries, but today many chargers have heat controls. When a battery heats up to 125° they disconnect it until the temperature drops to 100°. But don't be fooled into thinking that a fast charge can fully charge your battery in an hour. It can't.

If a battery needs repeated recharging, check for (1) dirty, loose connections in the charge circuit, (2) a faulty regulator that cuts the generator out too soon, (3) shorts or a stuck stop-light switch.

A battery ages just like everything else, and the plates slowly disintegrate. If one or more cells test significantly lower in voltage (or specific gravity) than the others, your battery is dying. Don't wait until it fails to replace it.

3 Battery Don'ts You Ought to Know

1. Don't propel the car with the battery except in dire emergencies. This heats the battery and may buckle the plates. It may also damage the starting motor. (But don't hesitate to use the battery to get a stalled car off a fast highway.)

2. Don't keep a starter turning over and over on a cold morning when the engine doesn't start right away. Let the battery rest a minute or so. Then try again. Rest gives the cold acid time to work into the plates.

3. Don't look inside with a match. Hydrogen gas, formed during charging, may blow up the entire battery.

3 Fill it regularly

KEEP the plates well covered. During spring, fall and winter you may get by if you have your fluid level checked every third week (or 1,000 miles, whichever comes first). But the service manager of one big company gives this tip: "In hot weather *insist* that the serviceman check it every *other* week!"

Do this even if you have one of the extra-capacity batteries which are said to need water only three times a year if you take proper care of them. One top engineer checks his battery every time he gets gas. Fluid should be 3/8" over separator tops in ordinary batteries, but a full inch over separators in the "three-times-a-year" batteries.

Don't overfill, however. This thins the acid and causes spray and spillage which corrode cables and cradle.

Some batteries have self-leveling devices in vent openings to prevent overfilling. If yours doesn't, ask your serviceman to use the kind of filler syringe that sucks back any excess water he may accidentally put in.

Some makers no longer insist on distilled water. Battery engineers, however, prefer distilled water when they can get it. Otherwise, they say, use any clear,

tested drinking water that has no odor or taste. Impure water is better than not enough water.

Caution: Don't fill your battery and then park your car in freezing weather without first driving it awhile. The water won't mix, stays on top of the acid and freezes. A battery that is only 50-percent charged will freeze (and probably break) at only 12 degrees below zero F. An uncharged battery freezes at 16 degrees *above* zero (never store one uncharged).

4 Prevent vibration

A BATTERY is more sensitive than you'd think. One that bounces in its cradle, on a rough road, shakes a storm of lead particles off the plates. These gather at the bottom and may short out the plates when piled deep enough. Meanwhile the plates lose their power.

The plates themselves may also bounce up and down and get out of line. Or the box may crack, or the sealing compound break open, spilling corrosive acid and developing a high resistance in the terminal connections.

Chafe marks on the box are often a clue to vibration. Even if you don't see signs of chafing, make sure the box is firm in the cradle. Tighten hold-downs properly. Caution: Don't tighten too much or the case may warp or break. To get firm tension, some dealers insert rubber washers under the hold-down nuts.

5 Keep case and cables clean

THIS is important with six-volt batteries, but far more important with 12-volters. Dirt, acid and moisture on top of the case conduct electricity. A lot of current escapes between the terminals (or between the hot terminal and the grounded cradle) in warm weather. Because of the voltage push behind it, a 12-volt battery loses four times as much current this way as a six-volter.

How to clean: Scrub the battery top with a stiff-bristle brush. Mop with a cloth dampened in ammonia or soda bicarbonate, to neutralize. Wash with clean water. Dry thoroughly.

Corrosion is a sign that acid is leaking (or spraying, a sign of overcharge) from the box. Corrosion attacks and weakens the cradle, eats away the connector bars and reduces their efficiency, chews into the cables and lowers their current-carrying ability, and builds up damaging resistance at the terminal posts.

Engineers say terminal clamps should be removed three times a year. Both clamps and posts should be scraped bright, then coated with petroleum jelly or mineral grease (which holds up better under heat).

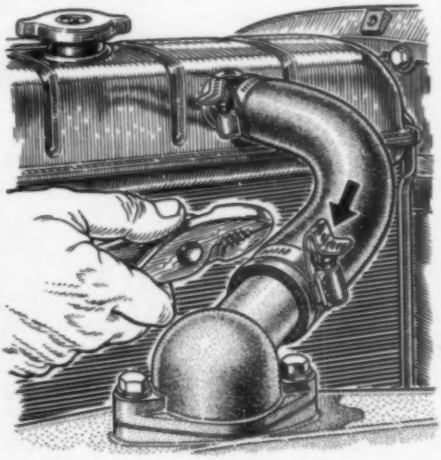
Replace worn, frayed or corrosion-eaten cables. They may short out, start a fire, or make it impossible for your battery to deliver enough power to the starter on a cold day. END

Hints from the Model Garage

Plastic squeeze bottles make short work of adding lubricant or fluid at hard-to-reach places on a car. Slice a little off each spout to enlarge the hole, and fill bottles with the proper oil for transmission, brake cylinder and differential.

To start a bolt in tight quarters try holding it in an extension socket with a piece of rubber band. Stretch the rubber over the head of the bolt and force it in the socket. When the bolt is seated, the socket can be easily pulled away.

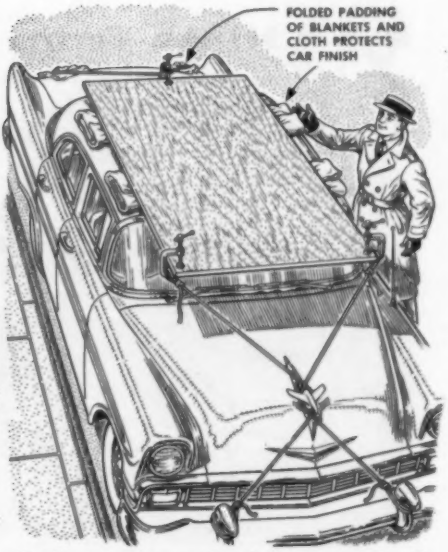
A pair of sleeves from an old coat or shirt will keep your clothes clean when you make roadside repairs. Cut them to fit above your elbow and roll them up for storage. Two rubber bands around the roll will also hold up the sleeves when worn.



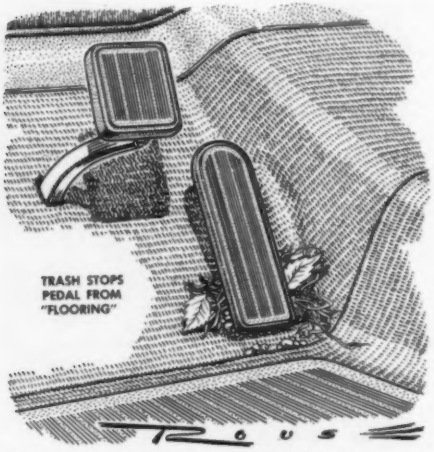
Tighten a hose clamp with this neat trick, copied from the Air Force system of securing bolt heads with wire: Bend the end of a gear-band hose clamp over the thumbscrew after it's been tightened. Now vibration can't loosen the clamp.

More Hints from the Model Garage

A non-skid floor area in your garage or carport may save you from a fall when getting out of your car in wet weather. Mask off a rectangle beside the car where the doors open, paint it with concrete paint and sprinkle it with coarse sand.



Hauling large panels of plywood or hardboard home from the lumberyard is easy if you use C clamps. Fastened to the ends of the panels, they hold them together *and* provide eyes for tying them down. Blankets protect the car's roof.



If your car won't downshift when you floor the gas pedal to actuate the kick-down switch, scrape behind the pedal with a screwdriver. Dirt behind its hinged base often limits pedal travel, sometimes so much that the car feels sluggish.

Do You Have an Auto Hint? Send It in and Win a Prize

HAVE you discovered or developed a money-saving short cut for making your own auto repairs? Have you found an easier way to do a difficult job? Got a tip that will make driving safer or easier? Or do you know someone who has?

POPULAR SCIENCE will pay a cash prize of $15 for every auto-repair hint accepted for publication in Hints from the Model Garage.

Describe your hint as completely as you can in words. Add a pencil drawing, or shoot a photo, if you feel that this will make your idea more easily understood. Address your entry to Model Garage Editor, POPULAR SCIENCE, 353 Fourth Ave., New York 10, N.Y.

FROM **Aroma to Coffee**

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CHANGE OIL AND FILTER, TOO!

For less than 1/20th of a cent a mile, a new AC Oil Filter keeps oil clean, protects your engine!

It's a fact . . . in the next 12 months, if you're an average driver, you'll travel over 15 times the distance from Aroma to Coffee for a total of 10,000 miles! The engine of your car will have to endure all driving extremes from hot to cold . . . crawling to cruising to climbing. All of these conditions can affect its performance and efficiency.

Your engine is the most vital unit of your car! That's why it's so important to give it the low-cost added protection of a new AC Oil Filter at least twice each year. An AC Oil Filter cleans all of the oil in the engine every 30 seconds at normal speeds . . . protects the precision parts from possible damage by dirt, dust, grit and bits of metal as small as 1/100,000th of an inch.

The next time you change the oil in your engine—change to a new AC Oil Filter, too! Your nearby AC Dealer will tell you how little it costs, how much it does for your engine.

Watch Walt Disney Studios' ZORRO every week on ABC-TV

AC THE ELECTRONICS DIVISION OF GENERAL MOTORS

With a gun in his back, the chips were down for Gus—but an old poker player never forgets how to bluff

Gus Does It by the Numbers

By Martin Bunn

RELUCTANTLY, Gus Wilson's weary eyes focused on a silhouetted figure waving its arms in the road ahead. "Trouble," muttered the Model Garageman as he peered through the windshield of the service truck into the fast-setting sun. The road was a lonely one, five miles off the main highway. Gus had been out on a farm all afternoon lending a hand with a balky tractor engine.

Pulling closer to the waving figure, he saw a late-model car, hood raised, stalled in the driveway of the old Lakeside Motel. Gus slowed down and resigned himself to a late supper. A thought twitched in his mind that the Lakeside was ordinarily deserted at this time of year. The elderly widow of the former owner lived there now and rented the somewhat rundown cabins occasionally to fishermen or hunters.

Gus eased to a stop and grinned down from the truck. "What's the matter, friend, no rooms available?"

The arm waver turned out to be a burly character who evidently didn't appreciate Gus's genial approach. "Me and my partner were just leavin'," he explained, "and this crummy car won't start. Then we get it started but it kept dyin'. We just made it in here last night."

Gus was about to offer his services when a smaller man got out of the ailing car and came over. "Come on, Mike," he said unpleasantly, "don't mess with this

"I'll write down what I need," Gus said. "You can take it to her and tell her I'm too busy working on the car to call."

blacksmith. You can smell the horse on his truck." Gus hadn't noticed it, but the truck did bear a faint memory of its visit to the farm.

"Sorry," Gus grunted, and dropped the idling truck into gear.

"Hey, hold it!" The big man's voice cut into the roar of the engine. Gus's jaw tightened but he stopped again. Big Mike waved the little guy back and spoke to Gus more persuasively. "Look, Mac, fix us up, will ya? We'll pay overtime and your boss won't even need to know."

"Skip it," Gus said. With a feeling that he was acting against his better judgment, he slid down from the truck with his tool kit.

HE NOTED the make, year and model of the car, then casually opened the gas cap and flicked the beam of his flashlight down the filler neck. This brought an outburst from the smaller man. "Hey, do we look stupid? There's a full tank there." Gus nodded and said nothing. Slipping into the driver's seat, he started the engine, with difficulty, listened briefly to its shaking and throbbing, and walked around to wiggle under the upraised hood. Reaching for his screwdriver, he quickly twisted the latches that held the distributor cap, lifted the cap, and shot his light at the exposed breaker points.

Mike leaned over the fender, his massive shoulders cutting off the little remaining light. "Look here," Gus said, as he probed between the points, "you've got to have a new breaker assembly. These points are burned blue."

"Yeah," the big man's jaw was hard, "and I supose you just happen to have a set on that truck?"

"No, I don't," Gus said mildly, "but I can phone my partner to run them out in about 15 minutes." He thought a moment. "Better see what made them burn so bad before I call. Might be something else we'll need."

A QUICK check under the hood showed the wiring to be in order. Gus then poked and prodded briefly under the dash panel, and a low whistle slipped past the stem of his cold and battered pipe. He knew suddenly that he was in very real trouble. He tried to conceal his discovery, but the two men seemed instantly aware that something was up.

"Fix it up, and no monkey business!" Mike was now pointing a large automatic pistol dead center at Gus.

Gus shrugged helplessly. "I'll still have to call for the new points."

"You ain't callin' nobody! Just fix it," Mike demanded.

Gus's heart started to pound. Now he had to bluff. "All right, fix it with that gun, if you can." He took a deep breath. "If you don't want me to call for parts, ask the lady who runs this court to do it for you."

The little man swore. "How could the old dame call? She don't know from nothin' about cars."

Gus explained it carefully, as though talking to a child. "Look, I'll write down what I need. You can read it, take it to her, and tell her I'm too busy working on the car to call." Gus Wilson was an old poker player; he pushed another chip into the pot. "You afraid of an old woman?"

Mike's lip curled. "Gimme the dope. It better not be a trick."

GUS scribbled a few words on an envelope he'd used for the day's bookkeeping, resolved that he'd forget all accounts involved if he lived through this mess. He'd scarcely finished writing when the hamlike fist grabbed the envelope.

"What's all this junk?" Mike exploded. " 'Bring new points for '57 Ford V-8 to Lakeside Motel. Is 2 hot on 184349?' " He shook his head. "Sounds fishy to me!"

Gus gestured impatiently with his flashlight. "It's near closing time. My partner will be gone in a few minutes. All the message tells him is that I need points and I want him to check the shop manual on the ignition circuit. That's the part number of the coil. Do you think I remember all that stuff on these cars?"

Reluctantly, the big man nodded at Gus. "Keep the rod on him," he said to the little guy, and strode rapidly toward the motel office. Gus tapped out his pipe, looked away from the baleful eye of the automatic and tried to think.

Mike was back too quickly. "This deal's no good. The old girl calls and right away this guy asks a lot of questions. Didn't sound like he knew about no part numbers or nothin'."

Gus knew his life probably depended

on Stan Hicks's being on the ball. "Stan said he'd come out, didn't he?"

"Sure," Mike said. "He's comin', but Buster, we ain't gonna be here. Either you're gonna get this car going, fast, or we're takin' your truck. It's slow, but it's better than walkin'."

Gus searched in his tool kit, finally came up with a point file. Working as slowly as he dared, he filed and set the points. The contact metal was almost gone. "I'll have to time it by ear," he said. He started the engine and made a few adjustments on the distributor. As he straightened up, something exploded behind his ear.

A flashing red light brought Gus back to consciousness. The police spot flashed painfully in his eyes, then flicked off as Jerry Corcoran's patrol car with Stan Hicks in the right-hand seat pulled to a stop. "You all right, Gus? Which way did they go?"

Gus grinned weakly. "I'm still kicking. I think you'll find them about a mile down the road with car trouble. Watch 'em—they're armed." His warning was drowned in the roar of the Interceptor engine as Jerry took out.

Minutes later, he was back. "State boys got your friends, Gus—I'd radioed ahead."

LATER, with a small white patch behind his ear and a sandwich in his hand, Gus Wilson gave his story at headquarters: "When I couldn't figure out why the points were burned so badly, I started checking the current supply to the coil. Like most 12-volt systems, this one has a resistance in the primary lead so the coil gets only six volts for normal running. When you turn the ignition key to start, you cut out the resistance by means of a second lead at the back of the switch and give full voltage to the coil for good starting.

"On this car," Gus continued, "I could see some tool marks on the back of the switch, and the wires were connected to the wrong terminals so the coil and points got double voltage all the time. I figured these fellows probably stole the car by jumping the ignition."

"That's right," Jerry cut in. "They're the prison escapees we've been after . . . What then?"

"Afterwards, while they were holed up," Gus said, "they either jimmied the switch up to work with a key, or installed a stolen one."

"Right again, probably," Jerry said. "The little guy is a lock expert."

"Anyway," Gus said, "they knew I was on to them. And I had to figure some way to get help."

"You'd better see Wimpley, our headlight expert."

STAN HICKS laughed. "You sure had me going. I finally decided that phony part number might be an engine number, and that 'hot' was good slang for 'stolen.' That's when I called Jerry to check."

Jerry nodded. "And the number *two* meant two persons, which was all it took to piece the puzzle together. I'm glad you're on our side, Gus."

Gus yawned. "I'm on your side all the way, Jerry, but if you'll excuse me I'd like to be on my back in bed for the next few hours. It's been a long day."

"One more thing, Gus," said the state trooper. "How'd you know that car would stop within a mile or so? They coasted right up to our road block."

Gus laughed. "I just pulled the coil lead around the exhaust manifold and reconnected it. As soon as the manifold got hot, the insulation burned through and grounded out the ignition." END

NEXT MONTH: Gus treats spring fever.

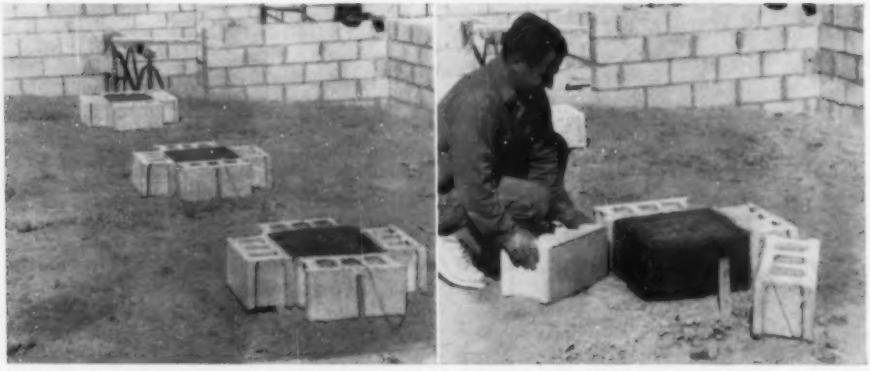
Short Cuts and Tips

FROM PS READERS

Scissor Grips Reach Topmost Kitchen Shelf

Now my wife has no more trouble plucking things off high kitchen shelves than a grocer with one of those long poles. I cut the handles for the scissor grippers from a single 3″-by-35″ strip of ¼″ plywood. Pivot holes were drilled off-center to improve gripping action. The two pieces were joined with a ⅛″-by-¾″ stove bolt. A flat washer on the bolt, between pieces, keeps them apart.

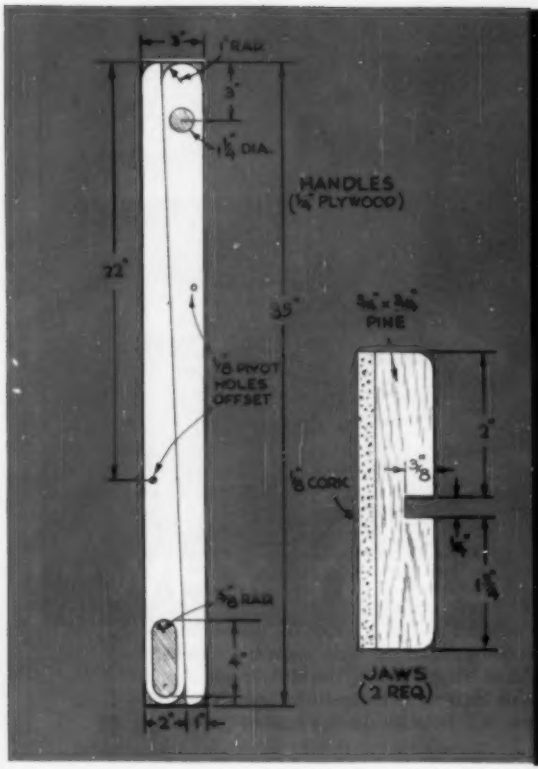
Gripper jaws were cut from two ¾″-by-4″ pine blocks and faced with ⅛″ cork. (I could have glued on strips of rubber or sandpaper instead.) The jaws were notched so that they would line up evenly when they were attached. —*Ronald L. Anderson, Minneapolis.*

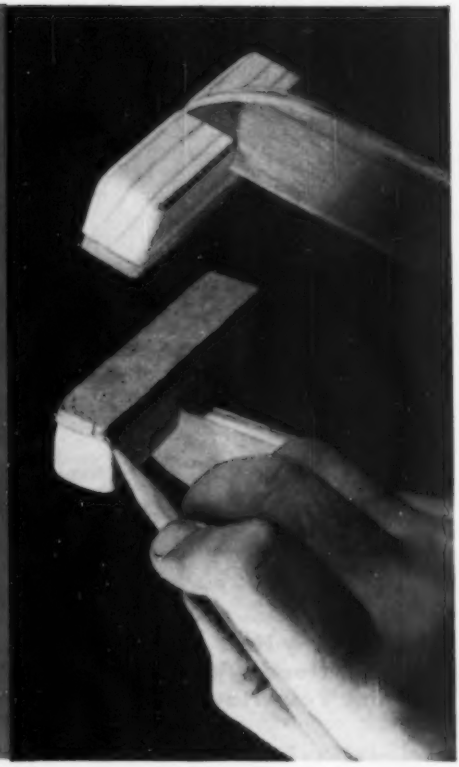


Blocks Staked in Place Make Handy Concrete Forms

A METHOD I use to build foundation piers can be used in other concrete work. I fill a hole 3′ deep and 20″ in diameter with concrete, to ground level. Then I set four concrete blocks around this, driving stakes along the outside of the blocks in order to hold them corner-to-corner.

After checking the blocks with a level I pour concrete inside the form. A form two blocks high can be made by binding wire around the top tier to prevent spreading.—*R. S. Wilkes, Keuka Park, N. Y.*





Old Iron Becomes an Anvil

SAVE the baseplate next time you throw away a worn-out electric iron. Bolted to a base of glued-up scrap lumber, it becomes a sturdy bench-top anvil that can be used for a variety of small jobs.—*Frank A. Javor, Newark, N. J.*

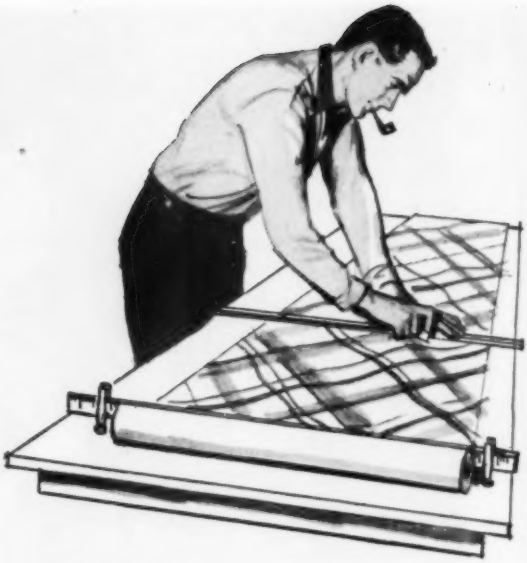
Sling Eases Battery Handling

I CARRY the battery to and from my motorboat in a handy sling. It's a scrap of old rug to which my wife sewed leather handles, using strong thread. Lugging the car battery with the carrier is just as easy.—*Lee H. Schrimpf, Tulsa, Okla.*

Short Cuts and Tips

Stop Holds Roll of Wallpaper Open

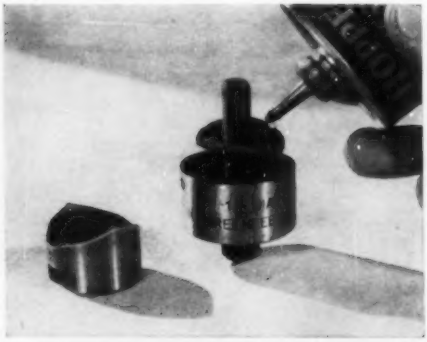
TRIMMING wallpaper is much easier since I made a stop to keep the roll from rolling up. I set a yardstick between two upright clothespins. My clothespins were pushed into holes drilled in the cutting-board top; they could just as well have been screwed to the sides of the boards.—*Victor H. Lamoy, Upper Jay, N. Y.*



Next Month

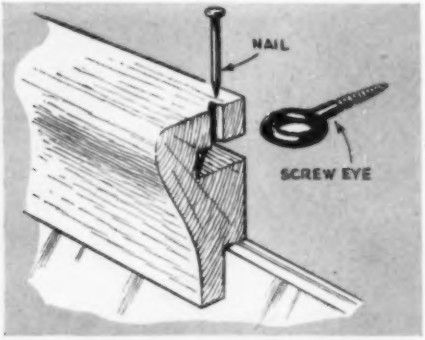
The Know-How You'll Need When You Paint Your House

FOR a second bonus booklet on house painting, a companion to this month's "Before You Paint Your House," be sure to get April POPULAR SCIENCE. Easy-to-follow drawings and text tell how to do the actual painting.



Felt Washer Oils Chassis Punch

A CHASSIS punch, used to cut holes in thin metal, such as radio chassis, should be kept oiled both in use and in storage. To assure constant lubrication, cut a felt washer to fit on the punch shaft inside the die, and soak it with penetrating oil. The washer won't interfere with use.—*Ken Murray, Colon, Mich.*



Hanging Pictures Flat and Level

HERE'S a way to hang pictures flush against the wall so they'll stay level, too. Cut or rout a slot along the back of the picture frame's top piece and drill a vertical hole at each end of the piece. Slip the slot over screw eyes on the wall and drop a pin through each hole-and-eye pair.—*Robert Emery, Lock Haven, Pa.*

"WHY TIRES GET TIRED"

IT WAS 4 A.M. in the parking lot and the tires got talking.

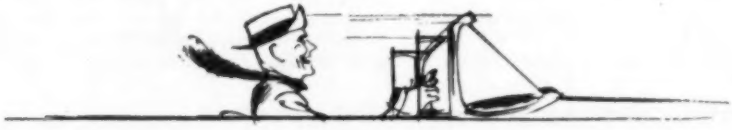
"Boy, it's tough," said the left rear. "Carrying car tonnage at 70 M.P.H. is bad enough without the driver punishing us, too."

"Yeh, sudden starts, stops and fast, sharp turns grind off rubber," said the right rear.

"Banging and scraping against curbs and rocks is bad," added the right front. "And under-inflation shortens our lives."

"Yes," replied the left front. "And the front wheels have excessive toe-in that's scraping us to the cords. When I blow the boss won't like it."

Smart drivers save. They have their tires checked (and rotated) regularly by their Texaco Dealer . . . and they buy their new tires from him – and batteries, too.



Why smart drivers don't get tired! A rough-riding chassis tires you, without your knowing why. It's worse if you get squeaks and rattles. That's the reason Texaco developed cushiony, smooth-riding Marfak chassis lubrication. Makes riding and handling easier and safer. Marfak seals itself in against dirt, dust and splashed water. Protects against wear. See your Texaco Dealer – *the best friend your car has ever had.*

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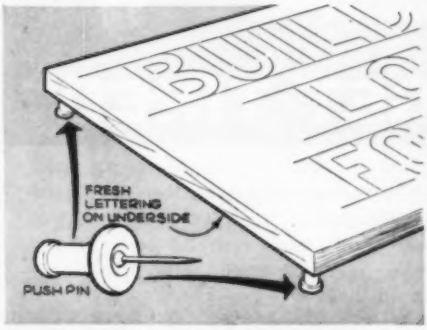
Short Cuts and Tips

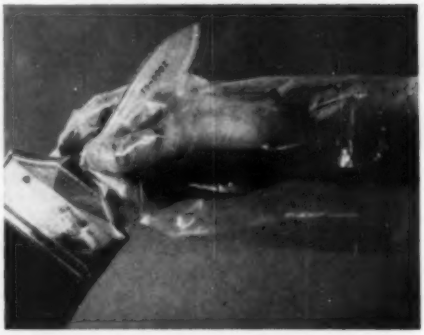
Drawer Pull Is Radio Handle

MOVING our small radio is no longer an awkward operation since I put a handle on it. After removing the chassis from the cabinet, I drilled two holes on the center line of the top for mounting screws. A dresser-drawer pull, held in place by the screws, provided the sturdy handle. —*R. A. Marquardt, Baraboo, Wis.*



Push Pins Speed Lettering

A SIGN painter I know doesn't wait for one side of a sign to dry before starting the other. At each corner of the first side he sticks push pins, as spacers to keep wet paint from smearing on the work table.—*Victor H. Lamoy, Upper Jay, N.Y.*

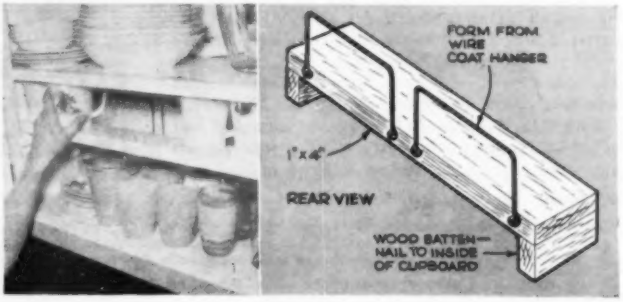


Plastic Bag Keeps Off Paint

I SAVE those light plastic food bags for paint shields. Before starting a messy paint job I slip my hand into one. It's roomy enough to let air circulate and saves me a hand-cleaning chore later.—*Ken Murray, Colon, Mich.*

Half-Shelf for Cups Leaves Back of Cabinet Clear

CUPS are up front within easy reach on a special cup shelf I built between two normal-height ones. It's shallow enough so that we can still store dishes behind it. Wire rails keep the cups from falling off the back of the rack onto the shelf below.—*Richard Lefever, York, Pa.*



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Short Cuts and Tips

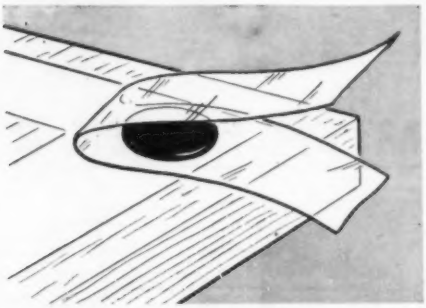
Carton Keeps Paint Off Floor

WHEN painting indoors, hunt up a medium-sized carton with sides about 6″ high and a flat, solid bottom. Put the paint can, brushes and other equipment in it and it will protect the floors and furniture from spatters, spills and other mishaps.—*W. R. Talbott, Lake Worth, Fla.*

▶▶▶WHEN a photographic tray gets stained by developer I clean it without scrubbing. First I wash it with a few ounces of a 10% potassium permanganate solution—just enough to cover the tray's surface. This is followed by several ounces of ordinary hypo solution, then a water rinse. Hypo removes any potassium permanganate stains from fingers, too.—*Eugene Hanson, Los Angeles.*

▶▶▶PRYING off and hammering on the lid of a glue can becomes a nuisance when it must be done frequently. Eventually the lid gets bent and lets air in, drying up the contents.

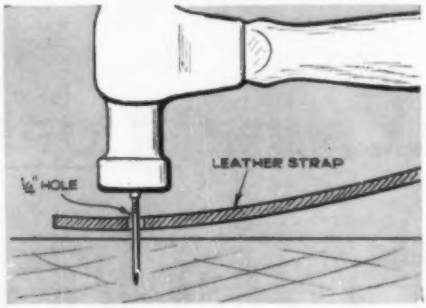
I replace the metal lid with one of waxed paper, glued over the opening. To use the glue I rip off the paper; to cover it later I stick on another waxed-paper lid.—*Robert Beasley, Jackson, Mich.*



Tab Is Handy Thumbtack Lifter

A TAB of cellulose tape stuck to the head of a thumbtack gives me a better grip when I push it in and pull it out frequently. I fold a 2″ length of tape around the tack head, sticking the two halves to the tack and then to each other.—*W. H. McClay, Pasadena, Calif.*

▶▶▶PAINT radiators when they're only moderately warm, rather than stone cold or very hot. Moderate heat tends to bake the paint on, giving you a long-lasting finish, while extreme heat cracks the finish.—*R. B. Ashley, Jacksonville, Fla.*



Strap Prevents Hammer Marks

I DRIVE finishing nails without denting the wood surface. After starting the nail, I slip a strap with a ¼″-diameter hole over it. Now the nail can safely be driven in flush with the leather strap and finished with a nail set. My strap is an old belt.—*R. T. Gidley, Dallas, Tex.*

▶▶▶A SPOT of grease rubbed on the rough, inner surface of a camera's groundglass makes it seem more transparent. I find that this improves focusing when a sharp image is important, as, for example, in copying.—*E. Manson, Santa Barbara, Calif.*

DELTA HOMECRAFT® TOOLS

make this "dream shop" come true in your home

You can own a shop as good looking, and good to work in as this one. Designed by Delta experts, it offers a big, T-shaped work bench, revolving tool rack, hide-away drawing board and many more unique convenience features. And New Advanced Design Delta Homecraft Tools (with exciting new styling by Raymond Loewy Associates, Inc.) give you *power* and *precision* you normally expect only in industrial tools costing twice as much!

START THIS SHOP FOR $17.10 DOWN

All you need to actually start building this shop is a Delta 9" Tilting Arbor Saw —basic tool of all woodworking—and you can have it delivered for as little as $17.10 down! Later you can add other New Advanced Design Delta tools—11" Drill Press, 4" Jointer, 10" Band Saw, Shaper, 14/11 Lathe, 16" Scroll Saw, and Bench Grinder —to complete your shop.

FREE WORKSHOP PLANS are yours for the asking—complete with bills of materials and easy-to-follow instructions. Write: Rockwell Mfg. Co., Delta Power Tool Div., 504-C N. Lexington Ave., Pittsburgh 8, Pa.

Do it now—and see all the New Advanced Design Delta Homecraft Tools at your nearest Delta Dealer, (listed under "TOOLS" in the Yellow Pages) or at leading Department, Hardware and Building Supply Stores.

DELTA POWER TOOLS

another fine product by

ROCKWELL

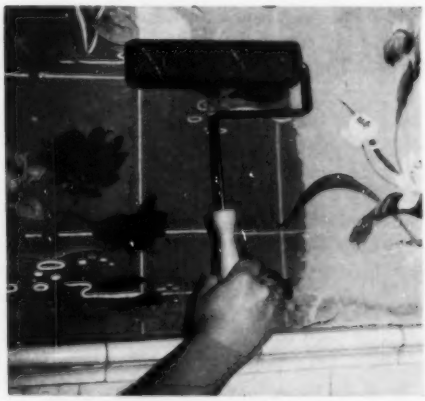
Short Cuts and Tips

Checkers on Dowel Space Ties

DRILLED checkers glued along a wood coat-hanger dowel form a handsome tie rack that permits you to space your ties neatly. Capping each end of the dowel is a pair of checkers, glued together and drilled part way through. Shallow grooves are chiseled in the meeting faces of these to accommodate the coat-hanger wire, bent to form a hanging bracket. Curl the ends of the wire, as shown, to take mounting screws.—*Frank Shore, NYC.*

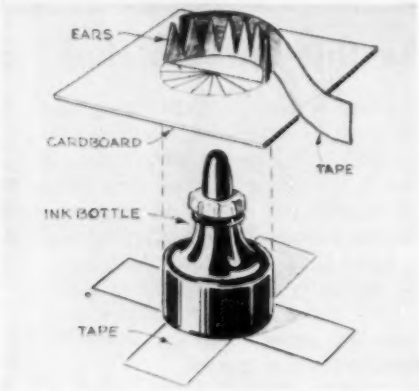
▶▶▶TIPS and articles of special interest are always easy to find again in my back copies of PS. Before filing a new issue away, I type the names of these items and their page numbers on a small sheet of white paper. I paste this on the lower left-hand corner of the back cover.—*Curtis L. Bader, Oyster Bay, N.Y.*

▶▶▶WHEN I have a messy tarring job to do I buy a dipper at the junk yard for a few cents. It's the headlight reflector from any pre-World War II car. It costs so little that it can be thrown away afterward. I seal up the bulb and rivet holes with solder and attach a broomstick handle.—*Robert Beasley, Jackson, Mich.*



Roller Soaks Off Wallpaper

A PAINT roller is handy, too, for soaking old wallpaper to make it come loose. I dip the roller in warm water and run it up the wall section by section, prying the paper off before it can dry again. The roller's width gives a broad sweep, cutting the work and mess down to a minimum. —*Frank A. Javor, Newark, N.J.*



No-Tip Stand Holds Ink Bottle

I MADE a simple ink-bottle stand by drawing a circle in the center of a 4" cardboard square, using the bottle as a template. After making a series of knife cuts across the circle's diameter, I slipped the card over the bottle and taped them together. Bottom braces were also taped. —*A. V. Malone, Glendora, Calif.*

Carburetor cleaning used to take hours!

That's right. Carburetor cleaning used to be a long, costly job. Today, it takes minutes. That's why the scene above is a familiar one in thousands of service stations and service shops. GUMOUT and the handy GUMOUTER Service Kit does the job in 20 minutes—and the carburetor stays right on the engine. You get a better tune-up job—and save money too. Ask your serviceman to give your car this quick, complete carburetor clean-out. Makes every car run better.

GUMOUTER Service Kit No. 610. The same kit your serviceman uses to clean your carburetor. Send for FREE 46-page Carburetor Handbook. It's full of helpful information about your car's fuel system.

YOU CAN CLEAN YOUR CARBURETOR, too . . . simply by adding GUMOUT to your gas tank regularly. It cleans as you drive. Available at auto supply stores, or wherever automotive products are sold.

THERE'S NOTHING LIKE IT!

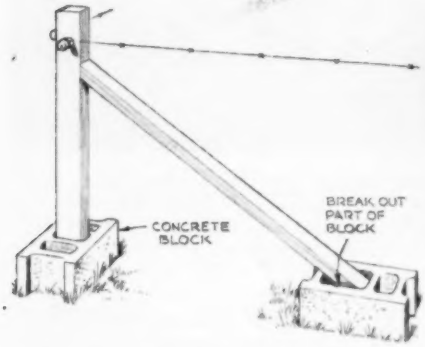
GUMOUT DIVISION

Pennsylvania Refining Company • 2670 Lisbon Road, Cleveland 4, Ohio

Short Cuts and Tips

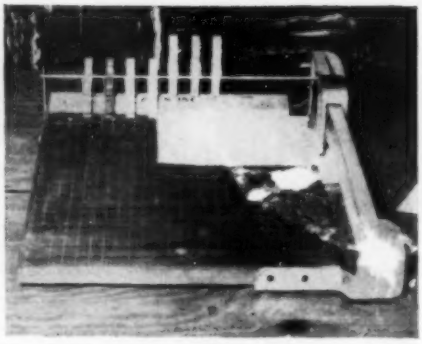
Ice Cube Licks Stamp Chore

NEXT time you have large batches of thank-you notes or other letters to mail, save your tongue and "lick" the stamps the easy way. Put an ice cube on a saucer or in a heavy glass furniture cup and rub the gummed side of the stamps over the cube.—*Lester Victor, Syracuse, N.Y.*



Concrete Blocks Support Posts

AN ELECTRIC fence will be anchored securely, but still be portable, if you set the upright posts and the corner braces inside concrete building blocks. Where—as at corners—you want to wedge in a brace, break away the wall between two openings in the block to make one large hole.—*Jay Lambert, Albany, N.Y.*



Clothespins Make Cutter Stops

PLASTIC clothespins serve as stops on my photo trimmer. Angle irons mounted on each side of the board support a 1/8" rod over the ruler. Depressions in the back of the pins grip the rod, but I can move them back and forth to any setting I want, or flip them back out of the way. —*W. G. Waggoner, Sacramento.*

Can Doffs Its Lid for Stool

WHEN bulk coolers replaced milk cans on a Kent, Conn., farm managed by Frank Miller, he salvaged one of the can lids and riveted legs of 1" strap iron to it to make this comfortable milking stool. It stands 11" high with its feet spaced 11" apart and the legs braced with 1/2" strap.

Grip Keeps Paint Off Hands

YOU can keep your left hand free of daubs when painting a picture frame if you tack a strip of thin wood across the back. The convenient handhold makes it easy to grip and position the frame for the brush.—*William Swallow, NYC.*

NEW!

all new PERMA-GRIT hand sander

REVOLUTIONARY NEW DISCOVERY

...lasts a lifetime of workshop use

THE MIRACLE OF

PERMA-GRIT

Tungsten carbide—industry's hardest metal—has long been used on production cutting tools. Now, SKIL has discovered a new process to manufacture abrasive tools for the handyman to use on wood, wallboard and compositions. Small particles of tungsten carbide are copper brazed under heat to steel. Keeps the particles permanently fixed in position. And each grit is a cutting edge that stays sharp for years!

Here's the sander to beat arm weariness and sanding boredom. A handyman's tool for sanding wood, wallboard, plastics or drywall joints. With a sanding surface made of particles of tungsten carbide brazed to a thin, steel sheet. When clamped to its sanding block, the sheet gives a cutting surface that removes stock twice as fast as any sandpaper! The exact spacing of the grit minimizes clogging. Deposits from gummy woods that ruin ordinary sandpaper are quickly removed with a wire brush or solvent. The Perma-Grit sander is sharp. Cuts fast all during its lifetime. Outlasts hundreds of sandpaper sheets. It's all here in one kit—1 Perma-Grit Sander, 1 Medium-Grit Shoe, 1 Fine-Grit Shoe—only $3.45.

AVAILABLE AT YOUR HARDWARE, LUMBER OR PAINT STORE

PERMA-GRIT WHEEL

Most amazing accessory ever made for a table saw. Tungsten carbide particles on edge and sides of 8" wheel. Actually 5 tools in 1. Saws, sands, dadoes, shapes, notches or ploughs without changing blade. Safe—no teeth. Only $12.95.

PERMA-GRIT FILE

Outperforms any other wood file or rasp ever developed. Resists loading because wide grit spacing gives self-cleaning action. Full 14" blade. Fine grit on one side with coarse on the other. Each—$2.25.

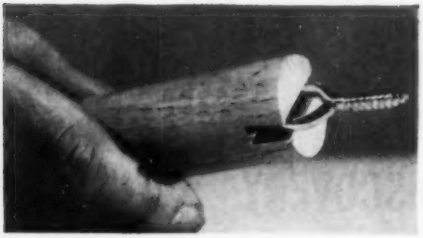
SKIL

Made only by SKIL Corporation, manufacturers of famous SKIL and SKILSAW products, 5033 N. Elston Ave., Chicago 30, Ill. In Canada: 3601 Dundas St. West, Toronto 9.

Short Cuts and Tips

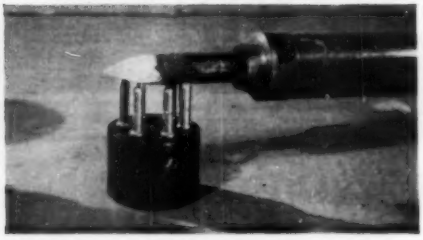
Why Not Burn Off Cable Wrapping?

To REMOVE the cotton wrap without fraying when preparing microphone cable ends for fittings, pull the excess out away from the cable and light it with a match. Just before the flame reaches the insulation, blow it out. You'll find that this method also works well with cellulose wrap.—*Hugh Lineback, Stillwater, Okla.*



I Made a Screw-Eye Wrench

TWISTING heavy screw eyes into wood can be tough on fingers. So I made a wooden holder that speeds up the job and makes it less painful. The screw eye fits into a slot cut in the end of a dowel.—*Harold Keepers, Philadelphia.*



Tube Base Holds Hot Iron

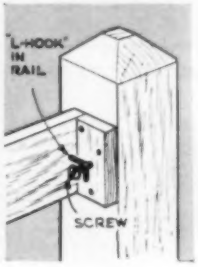
A HANDY support for the tip of a hot soldering iron is the base of a burned-out radio tube. Break off the glass envelope and the inside elements. The prongs on the tube's base keep the iron from rolling.—*Ken Murray, Colon, Mich.*

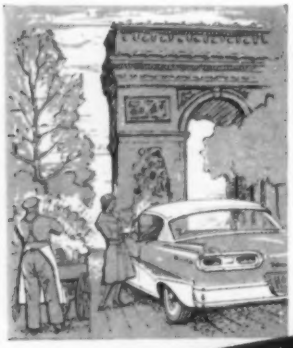
Tin-Snip Blade Reams Pipe

ALMOST every pipe-fitting job around the house, or on your car or boat, calls for reaming. If you don't have a reamer, try the tin-snip way. Open the blades at right angles to each other and insert one of them in the pipe. Use the cutting-blade handle to keep the blade steady while you are turning the pipe with your other hand.—*Ed Packer, Pompano Beach, Fla.*

Fence Rail Removes for Mowing

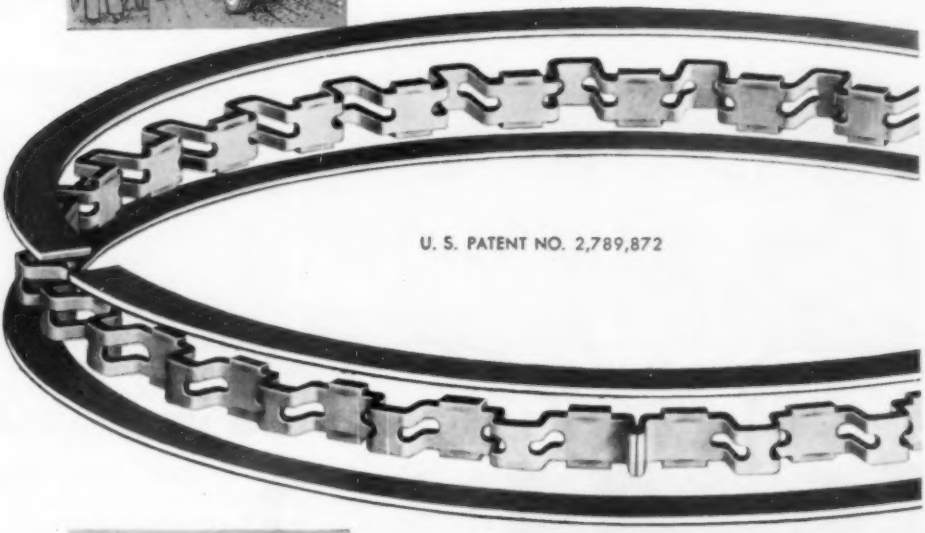
IF YOU'RE planning a fence around your house, consider building one in sections—fitted with L hooks—that can be lifted off the supporting posts. When you cut grass, the sections can be removed to let the mower through. You'll do a better paint job, too, on a fence that can be placed conveniently flat on a pair of horses.—*Richard Lefever, York, Pa.*



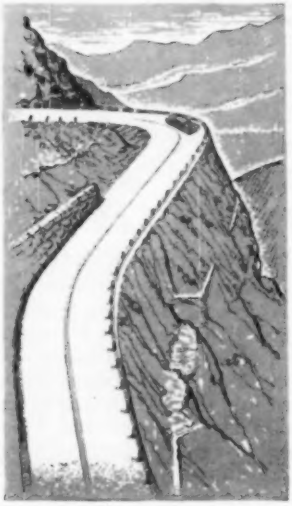


Sealed Power's

NEW STAINLESS STEEL OIL RING



U. S. PATENT NO. 2,789,872



WAS PROVED AND APPROVED AROUND THE WORLD WITH FORD

Deserts—mountains—rutted roads—sandy trails—heat—cold—great cities—tiny villages—through all these around the globe, the 1958 Ford was tested—and came through with flying colors.

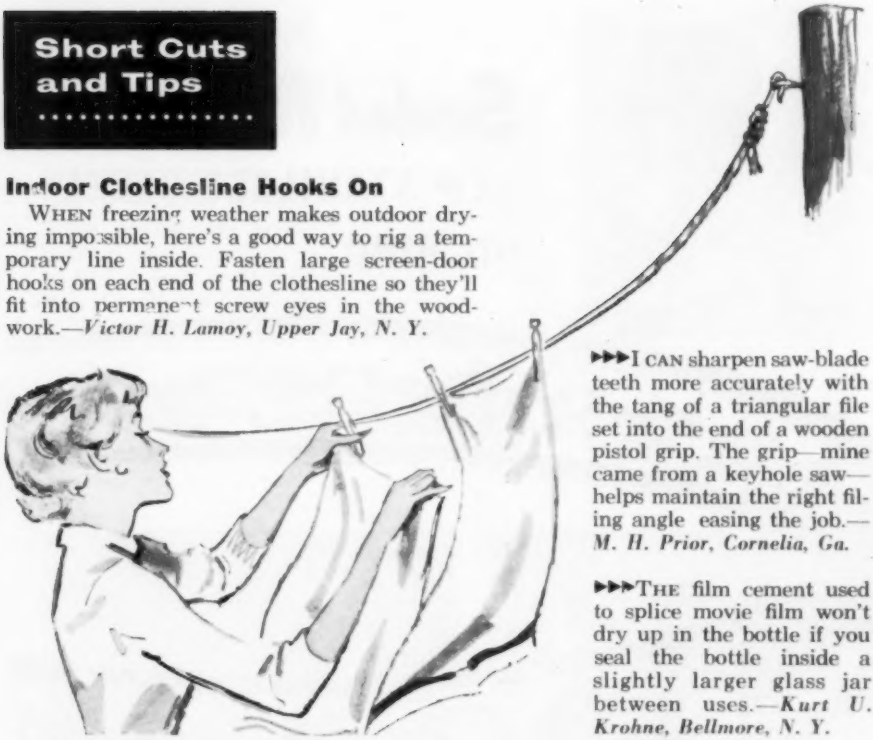
Also triumphant in the Ford engine were new stainless steel oil rings and associated compression rings by Sealed Power—setting their own records for performance, reliability and economy—the SEALED POWER SS-50U does things no other ring can do.

SEALED POWER CORPORATION
MUSKEGON, MICHIGAN

Short Cuts and Tips

Indoor Clothesline Hooks On

WHEN freezing weather makes outdoor drying impossible, here's a good way to rig a temporary line inside. Fasten large screen-door hooks on each end of the clothesline so they'll fit into permanent screw eyes in the woodwork.—*Victor H. Lamoy, Upper Jay, N. Y.*

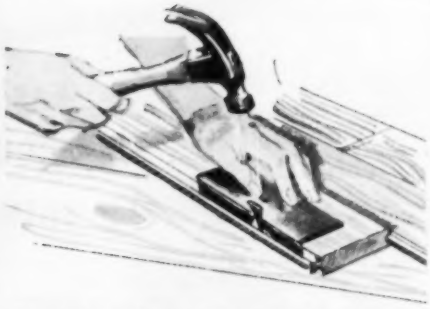


▸▸▸I CAN sharpen saw-blade teeth more accurately with the tang of a triangular file set into the end of a wooden pistol grip. The grip—mine came from a keyhole saw—helps maintain the right filing angle easing the job.—*M. H. Prior, Cornelia, Ga.*

▸▸▸THE film cement used to splice movie film won't dry up in the bottle if you seal the bottle inside a slightly larger glass jar between uses.—*Kurt U. Krohne, Bellmore, N. Y.*

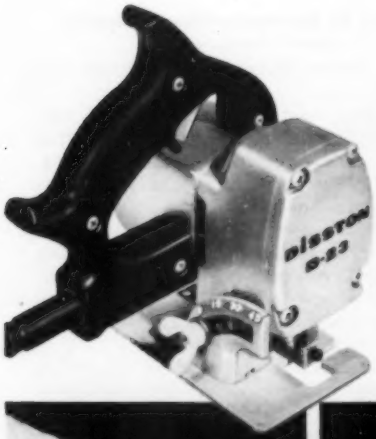
Tape on Brush Cleans Records

AN ARTIST'S brush with a piece of cellulose tape stuck on it makes a simple and effective cleaning tool for hi-fi records. The tape is pressed on so that about ¼″ of it overlaps the bristles. As the record turns, dust raised from the grooves is picked up by the flap of tape. When this flap loses its stickiness, cut it off and move the tape down to provide a fresh flap.—*Dr. John A. Passoni, NYC.*



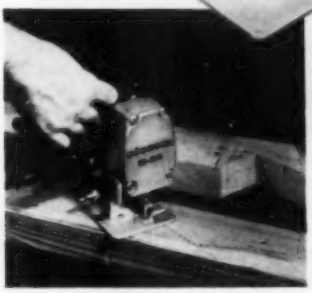
Flooring Guard Stops Dents

FINISH flooring stays dent-free when I nail it because I cover each board with a movable guard. The guard is a 6″ length of angle iron, shortened on one side to slide along the tongue of a plank. Nails are hammered into place through a notch cut in the middle of the short side. They can safely be hammered in flush with the guard, then driven home by a nail set.—*N. M. Pittman, Overton, Tex.*

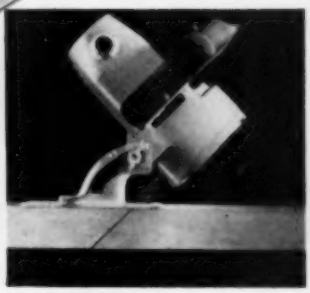


The most usable power saw you can own

The DISSTON D-23 ELECTRIC HAND SAW



Rips and crosscuts fast!



Zips through 2 x 4s at 45° angle!

Cuts ¼" steel, ½" aluminum!

Here's why the DISSTON D-23E is tough, fast, accurate!

VERSATILE: No other saw—regardless of price—can do so many jobs so well. Orbital cutting at 3800 strokes per minute, gives the D-23 a fast, professional cut in wood, plywood, plastics, floor tiling, laminated paper and cloth, nylon and plexiglas. It zips through steel and aluminum plate, angle iron, all types of pipe and tubing. Famous Disston special purpose saw blades come with this saw. Blade changing is easy, quick.

RUGGED: Like all Disston saws, the D-23 is built to last a lifetime! It's lightweight, yet delivers more actual cutting power than any saw of its type. It's the *only* power saw of its type with 100% ball and needle bearings. Hardened helical gears also provide added years of service.

FULLY GUARANTEED: With 4 blades, rip fence and detachable 10-foot cord . . . $98.50.

H. K. PORTER COMPANY, INC.

DISSTON DIVISION

415 Tacony, Philadelphia 35, Pa.

Sirs:

Please send me the free "Disston Workshop Manual No. 1" which explains operation of the versatile D-23 Electric Hand Saw.

Name_____

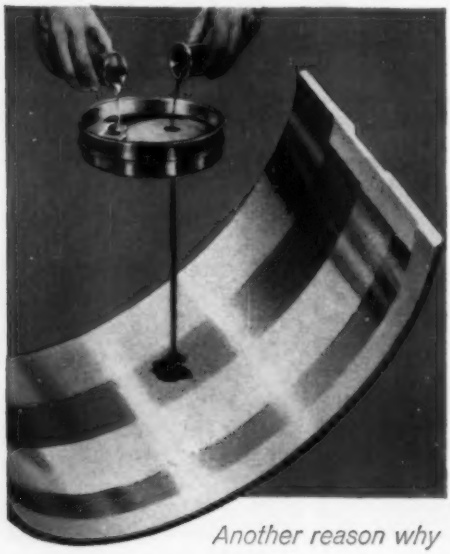
Address_____

City_____ Zone_____ State_____

FREE SHOP MANUAL

A screen so fine it "holds" water can't stop the flow of this metal powder for bearings.

Yet each dust-like powder particle is a carefully proportioned alloy of copper (for strength) and lead (for softness) . . . for fine performance!



Another reason why

FEDERAL-MOGUL *means* **FINE PERFORMANCE!**

We make millions of copper-alloy and other types of bearings each year for the engines of new cars, trucks, buses, farm, industrial and commercial equipment. We make additional millions each year to supply the nation's mechanics with the replacement bearings they PREFER to use to restore like-new power, pep and economy. If your engine needs reconditioning, remember Federal-Mogul bearings are *engineered* for the job. Ask your mechanic!

FEDERAL-MOGUL SERVICE

Facts on Correspondence Schools

[*Continued from page 131*]

". . . course spends too much time on theory."

Just one man complained about misleading advertising. A very few said that their courses were not up-to-date—and exactly the same number said that their courses *were* up-to-date.

What employers think. Failure to achieve recognition for valuable training was the correspondence graduates' most frequent complaint. So POPULAR SCIENCE followed up this point by checking with employers themselves.

We asked leading personnel executives what weight they gave to correspondence training when making promotions or hiring new employees. The answers suggest four different employer attitudes—not clear-cut, but tending to shade one into the other.

1. Any kind of education is a good thing: These very liberal companies believe that any effort of an employee to improve himself helps the company, too. They encourage, recognize and support all forms of employee education, in any subject, with any kind of school.

2. Each case is individual: The man is judged as a whole. His experience, personality and education are all taken into account. And the quality of the school is not overlooked. One personnel director mentioned the difficulty of making this kind of evaluation for correspondence schools.

3. Limited approval: Correspondence study is accepted, but training in a resident school is plainly preferred.

4. Outright disapproval: A few companies consider correspondence training definitely inferior, and refuse to recognize it except in unusual circumstances.

A major industry-labor organization surveyed 155 big and small firms that finance education for their employees, found that nearly two out of three included correspondence schools in their programs. (For comparison, three out of four of the companies included regular college courses.)

What it means to you: The POPULAR SCIENCE research suggests three major points for you to remember when you consider taking a correspondence course for yourself:

1. Don't expect miracles. Correspond-

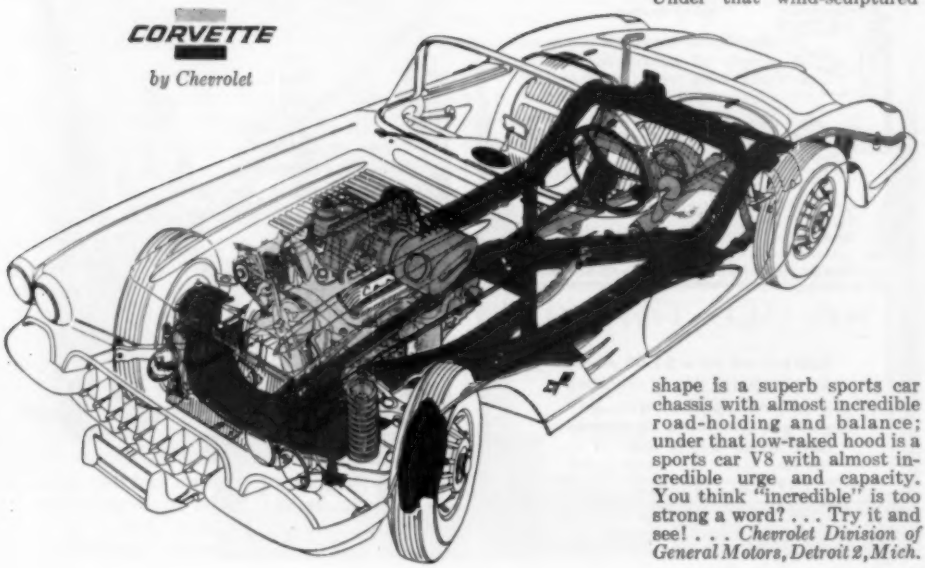
corvette for '58

CORVETTE
by Chevrolet

Brand new... and bred for action!

This is a very special car for special people with very particular requirements. We'll grant you it is as sleekly handsome a machine as ever whispered down a boulevard, with an individual flair that is shared by no other. And we'll also concede that its road manners are impeccable, that it moves with a glove-leather suppleness that is obedience personified.

But the real difference between the 1958 Corvette and any other American car is this: It is an authentic sports car. Under that wind-sculptured



shape is a superb sports car chassis with almost incredible road-holding and balance; under that low-raked hood is a sports car V8 with almost incredible urge and capacity. You think "incredible" is too strong a word? . . . Try it and see! . . . *Chevrolet Division of General Motors, Detroit 2, Mich.*

Special
TRADE-IN OFFER

Now get
$1.00
trade-in allowance for your old torch* toward this modern
BERNZ O MATIC®
All-purpose
PROPANE TORCH KIT

Regular retail price.....$8.88
LESS YOUR TRADE-IN... 1.00
now you pay only $7.88

*Any old torch—Gasoline, Butane, Kerosene, "Tin-Can" Type, Alcohol, Propane—regardless of age or condition.

Here's the kit you'll use hundreds of times—for home and auto repairs, thawing frozen pipes, hobbies, starting charcoal fires, laying asphalt tile, electrical work etc. Torch lights with flick of a match. Burns clean without soot. Plenty of heat. Up to 2300°F! Safe, disposable fuel cylinder.

NO OLD TORCH?

YOU can still get a $1.00 allowance if you clip this ad and bring it to your local dealer. He'll give you this $8.88 all-purpose torch kit for only $7.88!
(See pages 62-63 H.I.C. $125,000 Contest)

Otto Bernz Co., Inc., Rochester, N. Y.

Facts on Correspondence Schools

ence schools cannot deliver success *automatically*.

2. Be prepared to work hard—and steadily. You'll go faster if a knowledgeable friend can help you over the rough spots. And practical experience in the line of work you're studying will be valuable.

3. Make sure your employer (or the employer you hope to acquire) will accept your training at its real value. Some fields are especially receptive: utilities (electric, gas, telephone and railroad), textiles, accounting.

Keeping those points in mind, you should get out of a correspondence course what you put into it. The big majority of graduates do indeed make more money, win promotions, find better jobs.

The final questions we asked of correspondence graduates produced revealing answers:

"Are you still studying?"

Half said: "Yes."

And then:

"If you had it to do over again, would you take a correspondence course?"

Eighty-five percent said: "Yes." END

Oversize rifles dwarf marines

LEATHERNECK instructors find that jumbo mockups make it easier to demonstrate rifle functioning to rookies. Above are a Garand (left); two Browning automatics.

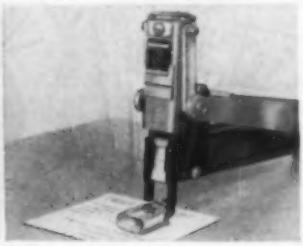
Stapling vs. spot welding
75% cost cut

Stapling vs. wire twists
60% cost cut

Stapling vs. hammer and nails
50% cost saving

Stapling vs. tape
1/10th the cost

Stapling vs. wire strapping
50% cost cut



Stapling vs. plastic cord
60% less cost

Win job recognition with cost-cutting stapling ideas

Suggest an idea that cuts costs as it improves your company's products or operations. It's a sure way to win favorable attention from your supervisors.

A Bostitch stapling idea may win recognition for *you!* There is a place for at least one stapling application in almost every business. Most companies have several fastening operations where Bostitch staplers and staples could do a better job, faster and at lower cost.

Chances for suggesting stapling economies are excellent wherever you work. And Bostitch savings often run into thousands of dollars a year. Your employer is bound to take notice of you if you suggest a workable stapling idea.

Start looking for ways to improve fastening in your company now. The check list will help you.

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Think of Bostitch stapling for
- ☐ preparing cartons for filling
- ☐ sealing filled cartons
- ☐ lining or padding crates
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Think of Bostitch stapling for
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- ☐ mounting products on display cards
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Think of Bostitch stapling for
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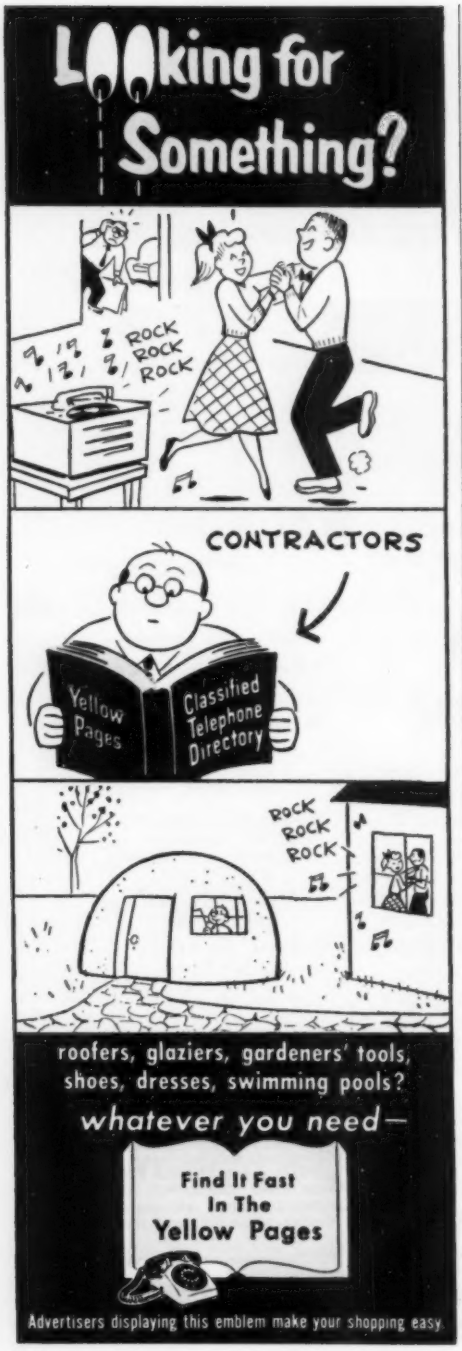

Detroit Tackles Car Mufflers
[*Continued from page 154*]

bigger, raise compression ratios and use wilder cams; the chassis engineers beef up the frame to handle the longer wheelbase—and when they are all through, somebody has to find a place to tuck in the necessary parts to quiet this snarling monster and dispose of its fiery breath.

The noise from an engine's exhaust is not, as the popular explanation goes, due to the "explosion" of the fuel in the cylinder. What you hear is the pressure wave created when the exhaust valve opens and the high pressure inside the cylinder suddenly expands. It's like popping the cork out of a champagne bottle. So the dimension of the noise problem depends on valve timing—on how much pressure is left in the cylinder when the exhaust valve opens.

The classic way to silence the exhaust is to let these suddenly released pulses expand into a closed container, then bleed pressure in the container to the outside at a slow constant rate. But all variations on this scheme require large enclosed volumes to get adequate silencing without excessive back pressure.

Since there is no longer room under a modern car for large-volume mufflers, the designers have had to come up with an assortment of acoustic tricks that will do the job in a minimum space. Their jargon sounds more as if they were designing hi-fi systems or pipe organs than automobiles.

The reverse-flow muffler, now standard on all Detroit cars, is the result. It combines (1) gradual pressure release, (2) destructive interference of out-of-phase sound waves, (3) carefully tuned resonators. It puts sound waves to work at self-destruction. You can get a rough idea of how this works if you remember that sound is a wave motion. If you bring two waves of the same frequency together so that one zigs when the other zags, they will cancel each other out. Result: The modern muffler can effect better quieting than its bulky counterpart of a few years ago—even though the problem is tougher.

It has one drawback, though, and this is something to keep in mind when you buy a replacement: It must be carefully matched to a particular engine and

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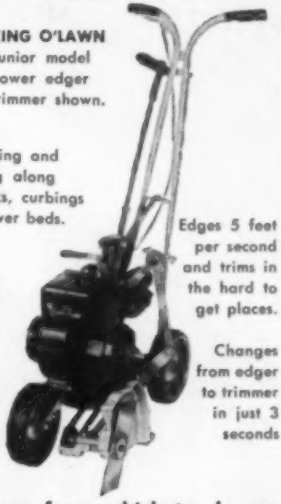

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installation to be effective. Chrysler engineers say, for example, that when they make even a slight modification in the camshaft or change the length of the exhaust or tailpipe, they must alter the design of the muffler.

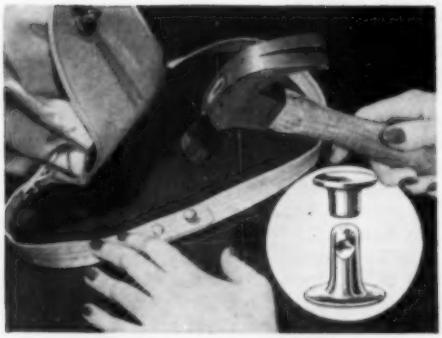
Here's why: Exhaust sounds have characteristic frequencies depending on engine r.p.m. The exhaust pipe behaves just like an organ pipe, acoustically. It has a particular resonant frequency depending on its length. When the engine speed produces this particular frequency the air in the pipe vibrates sympathetically and magnifies the noise. The engineers refer to this increase in noise at certain r.p.m.'s as a "period." The toughest period to cope with is the one that occurs at the fundamental frequency —a low frequency in the range of 60 to 100 cycles per second. But they also happen at higher frequencies—harmonics that are multiples of the fundamental frequency.

To kill this particularly annoying exhaust noise, a tuned resonator in the muffler is used to neutralize a specific frequency. A typical original-equipment muffler will have one or two low-frequency as well as several high-frequency resonators.

Tuning these resonators is critical. For example, they must be adjusted with the gas in the exhaust system at operating temperature. The tuning depends on the speed of sound, which varies with the temperature of the medium in which it travels. You can hear what happens when the resonators are only slightly off tune by listening to your exhaust when you first start up on a very cold morning. It will be substantially noisier until the exhaust reaches operating temperature.

The auto makers have done a good job of quieting today's stormy engines within the smaller space left by the low-slung styling. But they have been slow in admitting the need for more durable materials in the exhaust system. Now, at least, they seem to be facing up to the problem: Lifetime stainless-steel exhaust may be a selling point in 1959. END

Next Month: Just got a new car? April PS will tell you how to make friends with it on that Big Day when you drive it home from the dealer's.



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10.	5322	Socket—12 point (11/16" op., ½" drive)
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Which Dishwasher for Your Family?
[Continued from page 162]

ment supplies hot air that's blown over the dishes by a fan.

Most dishwashers make the same element that heats the water heat air, too. The impeller revolves in an empty tub during the drying period, circulating the warm air upward.

Pump or gravity drain? Water leaves a dishwasher by running out (gravity) or being pumped out. A gravity drain is the simplest and least expensive as far as the machine itself is concerned. But this puts the drain at too low a level to be connected to your sink and requires a separate drain below floor level.

If the plumbing for a separate drain line would cost more than $20, you might consider paying that much additional for a pump. This will send the water out through your sink drain line by means of a connection above the sink trap. Some makes supply a drain pump as standard equipment.

Portables. To tap the vast market of apartment dwellers and house-renters, manufacturers offer a wide range of these.

One group—Frigidaire, KitchenAid and Waste King—clothe their under-counter machines in portable attire and tag them at $40 to $60 more. But you can install these front-opening portables permanently if you become a homeowner.

Two other makers—GE and James-Universal—use the same mechanism and operating cycle as in their under-counter models, but add a lid instead of a drawer.

Portables in the largest group are completely different, in most cases, from their built-in mates. But they're very much alike mechanically, brand for brand. American Kitchens, Hotpoint, Kelvinator, Kenmore, RCA-Whirlpool and Westinghouse sell top-loading machines that wash nine place settings with a plastic impeller, use 6.3 gallons of water. They cost about $200. END

Next Month: Like to skim the waves in a speedy boat this summer—at half the usual cost? April PS tells you how to save by choosing a kit boat that you put together yourself.

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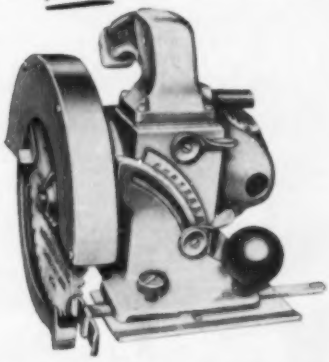

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What's Coming in Rockets
[*Continued from page 98*]

be assembled in the orbit. Fuel tanks surrounding a central structure would be jettisoned in flight as they empty. Chemical rockets would provide the thrust.

Exploration beyond the moon—interplanetary flight—calls for greater speeds than chemical propellants can achieve if it is to be practical. One reason: The vast distances involved make it necessary to cut down the time a crew would have to spend in cramped quarters, under taxing physiological, psychological conditions.

If the planet Mars, for instance, is your destination, Ehricke explains, you don't just aim your ship at Mars and go there by the shortest and most direct route. If you did, Mars would be somewhere else when you got there. What you have to do is get your vehicle into a high-speed, precalculated, elliptical orbit so that you and Mars will arrive at the same place in space at the same time.

One flight plan he has set up would be of about a year's duration. This involves 150 days each for the journeys to Mars and back, plus a 60-day "capture" period orbiting around the red planet. This capture period is waiting time while Mars and the earth come again into correct relative positions so that the return flight path will intercept the earth orbit. Otherwise, the ship would become a wanderer, an artificial comet, lost to the earth forever.

Although most of the time will be spent coasting through space, speed bursts of close to 20,000 miles an hour are needed to change direction and for orbit transfers, and perhaps as high as 30,000 miles an hour to escape the sun's gravity.

These speeds also bring Venus into the orbit of space travel. In fact, with Mars, Venus and the earth in an ideal configuration, both of the planets could be visited in one sweeping, round-trip journey. (The situation is so rare, however, that Ehricke doesn't consider this planetary double header to be practical.)

To achieve these terrific speeds, his manned interplanetary space ships would get their thrust from a nuclear source which stores about 1,000,000 times the energy per pound of chemical propellants. Actual exhaust velocity, however, would be only about four times as great.

If this type of engine becomes avail-

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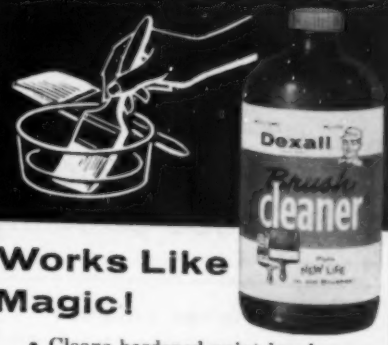

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able in time, Ehricke suggests that it be used for the second stage of earth-to-orbit space flight. It probably will be. Last November the Atomic Energy Commission announced that it plans to ground-test a nuclear-powered rocket engine in Nevada late this year.

When man has completed his preliminary reconnaissance of the inner solar system and is ready for a more thorough, detailed and extended exploration, Krafft Ehricke would have a more elaborate interplanetary space ship ready. It has crew quarters for at least eight persons in a horizontal gondola at the forward end of a 300-foot-long, tube-like structure. For crew comfort, it would be set in rotation to provide artificial gravity.

While rotating in an orbit, say 1,000 miles above Mars, crew members could leave the ship for a closer look at the planet. They would do this by lowering themselves in cable cars, shielded against radiation, to the vehicle's center of gravity and then launching themselves away from the mother ship in small, chemically powered "satelloid" rocket scooters. Before returning to the earth orbit, one of these satelloid ships would be left behind to orbit around the distant planet as an unmanned, instrumented satellite, sending information back to earth.

The inner solar system—the regions of Mars and Venus—appears to be the extreme limit that man can reach by means of propulsion systems now in use or in an advanced stage of development. For space exploration to the outer planets—Saturn and Jupiter—and beyond, more efficient means of power will be needed, such as ion- and photon-propulsion systems. Both of these are under investigation by the Air Force.

But Krafft Ehricke feels that they are not yet ready for application by practical spacemen of today. END

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Russia's Schools—and Ours

[Continued from page 107]

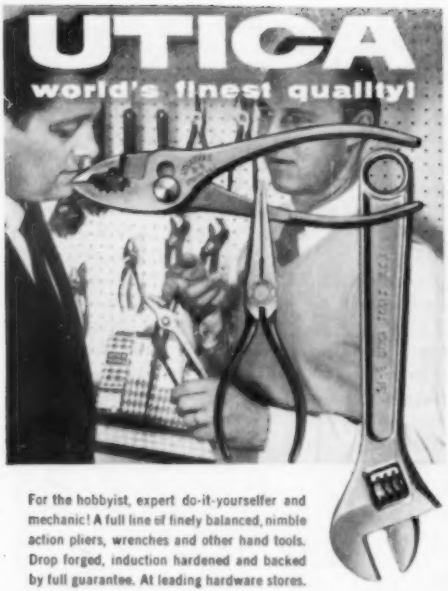
example, gives each and every student 1,353 hours of classroom and laboratory instruction in the sciences. Many of our high schools teach no science at all; only a third of our high-school graduates have even studied science, and the maximum obtainable, with a few exceptions, is 756 hours. (See PS, Nov. '57, "How Good Are the Science Labs in Your Youngster's School?")

It is time we face up to the fact that few American students at age 21 or 22 know as much after a four-year college course as most European secondary-school graduates know at age 18 or 19.

There is much dissatisfaction with our schools today. Parents feel vaguely that the local high school is below par but they have no way of proving it. In some fashion, we must devise a way to introduce uniform standards into American education. Since there is widespread distrust of the Federal Government in matters educational, and education is, under our Constitution, within the province of the states, it would be best to set up a private agency: a Council of Scholars, financed by our colleges and universities as a joint undertaking; or perhaps by foundations. This Council would set a national standard for the high-school diploma, as well as for the scholastic competence of teachers. High schools accepting this standard would receive official accreditation, somewhat on the order of the accreditation given medical schools and hospitals. Teachers would receive a special certificate if they completed the requisite studies.

Community pride would be a potent factor: For the first time parents would have a real yardstick to measure their schools. If the local school continued to teach such pleasant subjects as "Life Adjustment" and "How to Know When You Are Really in Love," instead of trigonometry, French and physics, its diploma, for all the world to see, would be inferior. Taxpayers will begin to wonder whether they are getting their money's worth when they see other schools receiving accreditation, and when their children find admission to college difficult because *theirs* is an inferior diploma.

Schools would soon discover that to obtain the coveted accreditation they



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SAVE $200 to $300

Just connect this low cost 250 amp. unit to any good used auto engine and you're equipped for a highly profitable welding business. Investigate this wonderful opportunity for making more money by mailing the coupon below.

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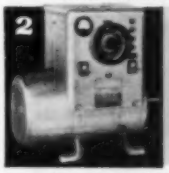

200 amp. combination that you can connect to your own power source. Lets you operate where no power lines are available. Furnishes current for welding and power for running tools, lights, motors, etc. Build your own combination welder and power unit with a good used auto engine.

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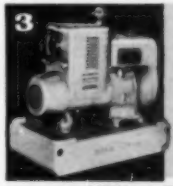

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would have to have teachers with a thorough knowledge of their subjects.

This would put pressure on educators and state authorities to bring their teacher-certification requirements into line with today's need for teachers thoroughly grounded in the subjects they teach. Another most desirable effect would be the enviable position in which Council-certified teachers would soon find themselves. There would be lively bidding for their services with the near-automatic result that their salaries and prestige would rise. More intelligent people would then be drawn into teaching.

As part of what I feel must be a concentrated effort to introduce quality education into the high schools, I urge that industry, labor, and the foundations endow some 25 model high schools which would be open to all children, but only upon passing rigid entrance examinations.

Once scholastic standards are firmly set, the Council should concern itself with a plan to shorten American general education to at most 14 years; and to 12 or 13 years for brilliant children. It ought to work out a plan for all high schools to graduate at age 16 those children who are able to learn fast and who plan to become professionals; colleges would probably accept the 16-year-olds if they came with a Council-accredited diploma.

We are in our present predicament because education in America has deteriorated in quality for lack of standards. You can send your boy to college to study Flycasting or Advertising Layouts, your daughter to study Etiquette and How to Be a Hostess. Every American child has the God-given right to march in a commencement procession, clad in mortarboard and academic gown, the rolled-up parchment degree clutched in his hot little hand.

It matters not which courses you take. Everything is grist to the American educational mill. "You, too, can have a degree."

Let not men of little vision with their soothing words hold back our righteous anger. We must sweep clean the temple of learning and bring back quality.

Let us each make a beginning, however small. It takes but the moving of a single pebble to start an avalanche. END

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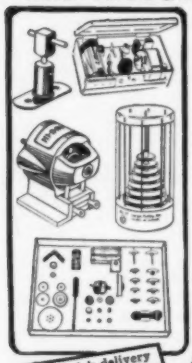

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ARC WELDER KIT—$26.00 Build your own complete make-up package incl. 1 Aircraft DC Gen. 200 Amps. 24 V; Rheostat, Toggle Switch, 1 Ammeter, Electrode Holder, Welder's Shield, Voltage Reg. Simple instruction wiring diagram. Wt. under 100 lbs. Approx. GOVT. COST $475. Like new, perfect. All units guaranteed pre-tested. $26.

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Great for tree, termite, airbrush & paint spraying; filling tires, aquariums, etc. Dual & remote control electric receptacles. 115V 60 cycle AC, 1/3 HP. Westinghouse Motor. Direct drive. Water & explosion-proof. Built-in air filter, adjustable pressure setting up to 47 lbs. Built-in pressure gauge. Self-contained switch. Mounting brackets. These units made under license of Sperry Gyroscope Co. Wt. 66 lbs. gross. Approx. GOVT COST $585. Like NEW. $21.95.
With portable steel hand cart (shown), rubber wheels, specially constructed for mounting this unit. Incl. 15' rubber air hose, 6' extension cord with plug & fittings. Wt. 76 lbs. Complete with cart—$26.95.

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BENDIX AIRCRAFT COMPASS For boats, trucks, cars. Pioneer Instrument Co., div. Bendix. Mark VIII. Increments of 1°. 360°. Major graduations every 5°. Magnetic. Can be lighted with 6, 12 or 24 volt standard bulb. Flush panel mounting. Floating card. Tested in our own inst. lab. Approx. GOVT. COST $250. Perfect. $10.95 ppd.

ASTRO COMPASS MARK II Used by USAF & commercial airlines. Makes pelorus & azimuth circle for air or marine navigators. Great for astronomers. Incl. carrying case. Tested for accuracy in our own lab. Approx. GOVT. COST $400. Now $10.95.

BENDIX GEROTOR PUMP & MOTOR
Use wherever fluid pumping required. Excellent for hydraulic installations. Has 3/4" pipe connections, built-in relief valve adjustable up to 1500 lbs. Max. cap. 6 GPM. 1½ H.P., 24 V. motor. Use on 12 to 36 V. Approx. GOVT. COST $350. NEW. $10.95.

140-1 REDUCTION GEAR For beaching boats, winches, hoists. Ideal for motor in golf or boy's electric car. Built-in (removable) DC motor & clutch. Hi torque, lo speed. Runs on 6-12 or 24 V. Wt. 65 lbs. gross. Approximate GOVT. COST $300. Like NEW. $12.00. Matched splined gear for above—$3.00 ea.
*225-1 REDUCTION GEAR—$13.50.

REVERSIBLE RATCHET WRENCH
Hi torque. Delivers tremendous leverage. 4' handle with reversible ratchet. 4 hexagon nut sockets, 2 5/8", 2 9/16" & 3 1/8". Mfd. by Lowell. Approx. GOVT. COST $215 per set. Wt. 50 lbs. NEW. Only $9.95 per set.

SPECIAL ON $4770 NAVY AIR-COOLED POWER UNITS Tremendous power package. Can be used as a portable or stationary unit. Makes terrific welder. 30D-1A Lawrence. 24V. 2 Cylinder opposed 4 cycle 10½ H.P. Complete with various generators. Net wt. 180 lbs. Gross wt. 250 lbs. Like NEW. With 140 Amp. 24 V. Gen. — $125. With 200 Amp. Gen. — $137.50. With AC-DC NEA5, DC side 24 V., 200 Amps.; AC side 10.5 Amps. 800 cycle — $142.50. 300 Amp. Gen. — $143.50.

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Runs on 12 or 24 V. Centrifugal type. Pumps 500 GPH. Complete with on and off switch rheostat, 2 speeds (hi & lo). Mfd. by Ingersoll-Rand. Shpg. Wt. 7 lbs. Approx. GOVT. COST $195. NEW. $8.95.

HEAVY-DUTY RHEOSTAT Ideal for regulating voltage on electric welders. Rated 5.75 Ohms, 100 Watts with double windings & dual female 25 amp., 125 V. receptacles. 7" hi x 5¼" D. Shpg. wt. 2½ lbs. Approx. GOVT. COST $25. Brand New. $2.25 ppd.

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MICROMETERS Black crackle finish frame. Easy-to-read graduations in .001. Nr.W. 0-1" cap. $2.69 ppd. 1-2" cap. $3.79 ppd.

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CHAMPION DeARMENT TOOL COMPANY
MEADVILLE, PENNSYLVANIA

The Blasting of Ripple Rock

[*Continued from page 111*]

addition, long feelers are sent out ahead of all drilling. In practice, two diamond drills punch holes 100 feet ahead of a tunnel, one hole on either side. Near the top of Ripple Rock, diamond drills pushed all the way up to salt water; then the end of the opening was sealed off. By this means engineers knew exactly where they were working and also where to place the explosive.

As a precaution, a deep-well pump capable of pulling out 1,000 gallons of water a minute was installed at the bottom of the Maud Island shaft, and wiring, motors and switches were placed above ground on the island to guard against sudden tunnel leakage. But so little water was encountered that the pump got a workout only during routine weekly tests.

The explosive will be placed so that both domes will be blasted away to a depth of at least 40 feet below low tide. To accomplish this, blasting must be done at a still greater depth, since some rock will fall back on the broadened surface of the two domes. Explosives will be placed down to a depth of 70 feet below low tide.

The amount of rock that must be removed is staggering. Just to clear to the 40-foot mark will require the removal of 50,000 tons on the north dome and 20,000 tons on the south dome. To take the two domes down to the 70-foot level will require removal of a total of 251,500 tons. That's equivalent to 4,200 railroad cars of rock that must be cut loose and moved in one mighty roar.

For this chore close to 1,500,000 pounds of explosives will be packed into the tunnels of Ripple Rock.

The explosive selected has an ammonium nitrate base. This is the same chemical that gardeners use for fertilizer. It is the same product that caused the Texas City fire and explosion in 1947 at a cost of 560 lives. Ripple Rock will have about one-third as much explosive as went up at Texas City.

Ammonium nitrate was chosen for several reasons. It is easy to handle. The explosive is packed and sealed in steel cans, two feet long and almost six inches in diameter. And it is highly insensitive to shock. A careless workmen can drop a can and nothing happens. A deer hunter

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Completely finished—even waxed—at the factory, Crestwood requires no sanding or finishing. It's ready for use as soon as it's laid, and will give your home rich style and beauty.

Crestwood is packaged in an easy-to-handle carton containing enough flooring (with proper nails) to cover 25 sq. ft. of floor area. Flooring strips have tongues and grooves for blind nailing, with nail positions marked on tongues for your convenience and to assure adequate nailing.

A new Bruce Crestwood Floor will cost you less than a good rug or carpet . . . and will last the life of your home. Sold by leading lumber dealers. Mail coupon below for colorful literature.

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Send literature on Bruce Crestwood Floors to:

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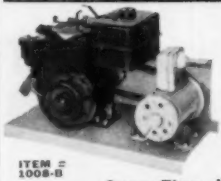

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ROLLER BEARINGS FOR WOODEN DRAWERS

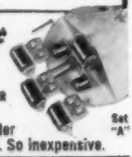
- EASY, QUICK to INSTALL in FURNITURE, BUILT-INS
- MAKES WOODEN DRAWERS OPERATE SMOOTHLY EVEN IN HOT, HUMID WEATHER

Stop breaking your back trying to open that stuck drawer! Sensational Roll-eez Set "A" cures the cause of stuck drawer troubles by eliminating friction of wood-against-wood and maintaining drawer alignment. Made of noiseless, self-lubricating NYLON rollers mounted on steel frames. Each drawer set includes simple instructions and nails. Anyone can install. Used by cabinetmakers to provide lasting convenience in homes of every price range. At Hardware, Building Supply dealer. If he does not stock, remit to factory.

Action Compares with Costly Slides

Nail two Roll-eez "N" to rail at drawer opening. If drawer has center guides, nail third Roll-eez "N" on top of back in middle, and Roll-eez "M" on bottom of back, straddling guide.

49¢ SET FOR ONE DRAWER



Set "A"

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Building, Remodeling? Ask Builder to Equip Cabinets with Roll-eez. So inexpensive.

Junior-Pro Prod. Co., Dept. P 118 E. Marceau, St. Louis 11, Mo.

The Blasting of Ripple Rock

can send a bullet through a can, and still nothing happens. Because the cans are sealed there are no fumes and no possibility of spontaneous combustion.

Carefully spaced among 30,000 powder cans will be 300 detonating cans. Fuses will lead to these detonators, which will then act like blasting caps and trigger the ammonium nitrate.

Double and sometimes triple fuses will lead to each detonating can to be sure of no misfire. These high-speed fuses burn at the astonishing rate of 21,000 feet per second, and for the short distances here, will provide instantaneous detonation for the entire area.

The explosion itself will be set off from a shelter on Quadra Island, one stepping stone beyond Maud Island. The shelter will be cut into bedrock. It will have a solid wall of rock for a direct shield against the blast. The roof will be of heavy timbers, with successive layers of timbers eight inches square covered with sand bags.

Careful timing will be necessary. Low tide will be wanted to lighten the weight of waters that the powder must lift to throw the rock clear. Yet some current will be wanted right away to move the falling debris. Clear weather will be preferred, to prevent the focusing of shock waves from the clouds, and mild weather will make it easier for those who must leave doors and windows open. From the standpoint of fisheries, March is probably the best month for so destructive a blast. The fish aren't migrating through the narrows then.

Perhaps when a nervous hand touches a flaming match to the detonating fuse, remote-control cameras will catch an astonishing spectacle, of rock, muck and seawater roaring over a hushed and vacant area where a moment before only the cry of the sea gull was heard.

Will this blast, after all these years and wasted lives, finally drive Ripple Rock so deep it can never again claw a ship's bottom? Many an anxious mariner, mucker and engineer will be waiting to know. This much is sure: After the coming explosion Ripple Rock will be so badly, so deeply, fractured, that never again can it be tunneled and blown. In man's battle against Ripple Rock, it's now or never. END

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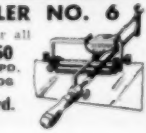

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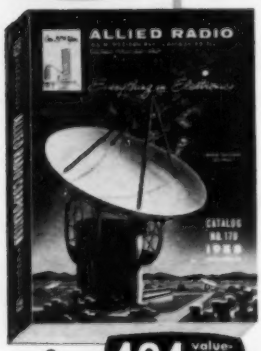

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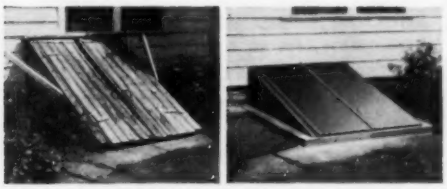

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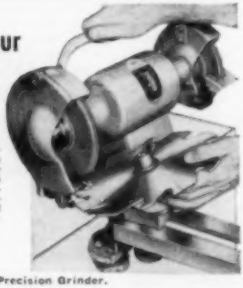

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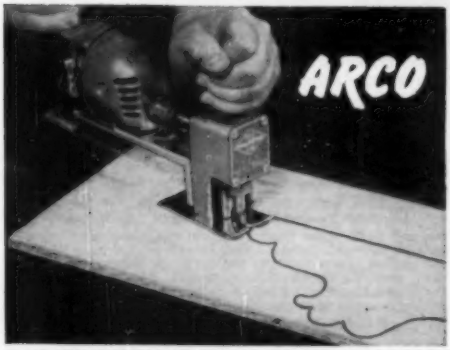

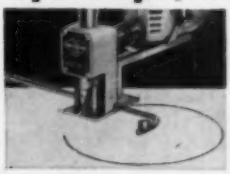

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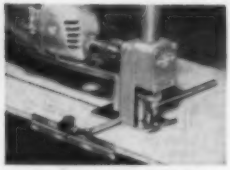

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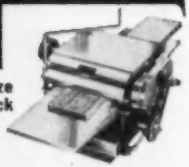

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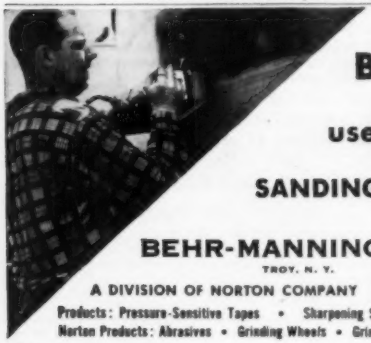

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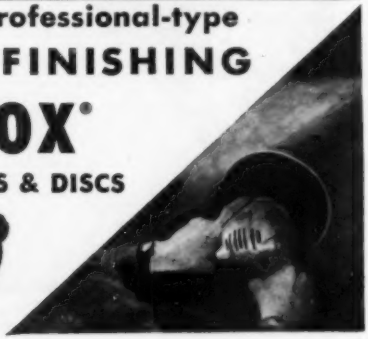

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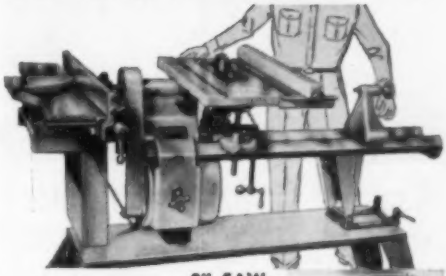

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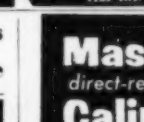

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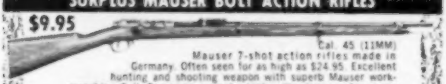

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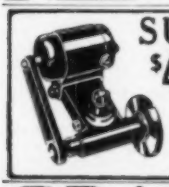

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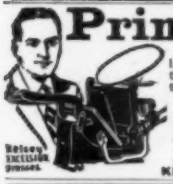

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Fresh Water from the Sea

[Continued from page 120]

War II she was horrified by the details of the painful ordeal of Eddie Rickenbacker, whose plane was forced down in the Pacific and who drifted many days on a little raft, almost dying of thirst.

Determined to help men in such a plight, Dr. Telkes developed a compact solar still which produced about a quart of fresh water a day from ocean water. Mass-produced and put into every aviator's emergency kit, it saved the lives of many who were forced down at sea.

Dr. Telkes has since built a different type solar still, for civilian use. In its simplest form, it looks like a miniature greenhouse—just a four- or five-square-foot tray for salt water, roofed by a slanted glass pane. Sun shining through the glass warms the brine flowing through the pan. Vapor condenses on the inner side of the slanted glass and runs into a gutter for collection. On a bright, sunshiny day, one of these small solar energy factories yields about a gallon of fresh water. It produces about half as much on cloudy days, and in weather of 40 degrees in New York without bright sunshine it turns out a quart or more. In freezing weather, it ices over and cannot be used. At the University of California, five stills of this type, occupying 1,000 square feet, ran successfully for three years, producing up to 100 gallons of water a day.

Dr. Telkes described her work in a scientific journal. Cyril Gomella, a government engineer in Algiers, read about it with intense interest. Modifying her diagram, he made a solar still of his own. Mr. Gomella told me in November that 120 solar stills were then at work in the Sahara Desert, converting brackish oasis water. These stills were built by men who foresee mass production.

Another man who read about Dr. Telkes' work and did something about it was an Australian, the late Sir Frank Beaurepaire, whose holdings included an automobile-tire repair service. He had a Telkes-type still constructed at Mildura to provide water for car batteries. With a 48-square-foot tray, he got from seven to nine gallons a day.

The cost is still high—about $3 for 1,000 gallons of fresh water. But Australia's need is great. Its water problem stems from the fact that it is surrounded by the sea, and strong winds carry salt spray far inland. Salt collects and seeps into the soil. A large underground basin of briny water has accumulated. Many wells and even rivers are brackish. Fresh water is so scarce that it takes an acre of land to graze two or three sheep. After a news story on Beaurepaire's solar still, so many sheep growers requested further information that the government has recently published a "build it yourself" chart, showing in eight steps how to construct a still to make two gallons a day in summer and from one to two pints in winter.

Spearheaded by the Interior Department's Office of Saline Water, which stimulates private interest and sponsors research, scientists are increasing efficiency of proven methods and developing new ones. Two large experimental pilot plants operating at Wrightsville Beach show great promise in producing fresh water from the sea at a much lower cost than is now possible.

In Syracuse, N.Y., Carrier Corp. has a pilot plant converting sea water by freezing. When salt water freezes, the ice crystals are pure water—the salt clings to the outside. It clings tightly, and washing it off is at present the major problem. Carrier men, however, already turning out 100 pounds of water an hour, are making progress with this new approach.

So the treasure hunt of the water scientists goes on, striving to provide a continuing and plentiful source of water for our industry, agriculture and homes. This is one of the truly great tasks of humanity. Their work so far gives reason to believe that before long they will unlock the secret of the ages and that our generation will indeed drink water from the sea. END

NEXT MONTH: How does it feel to be weightless? Popular Science sent ex-Navy pilot Eliot Tozer down to Randolph Air Force Base, Tex.—where they are studying the effects of zero gravity on human behavior—to find out. Read Tozer's vivid account of his strange sensations as he flew the parabolic arc that cancels out gravity—"I Was Weightless for 39 Seconds"—in April PS.

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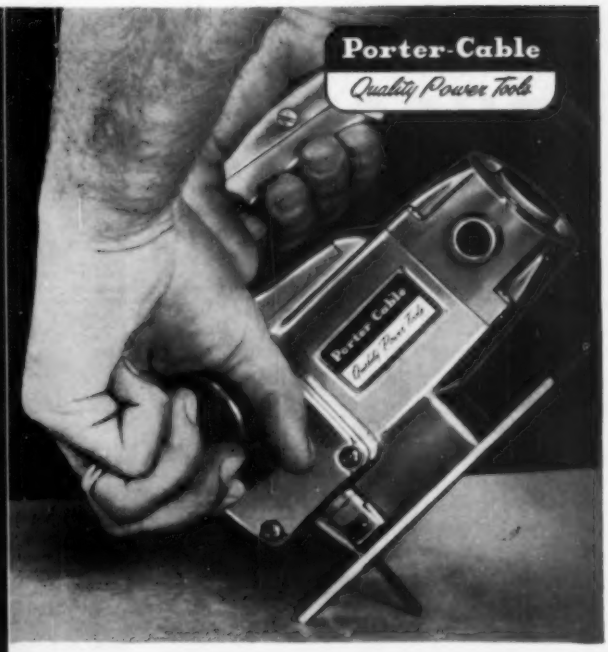

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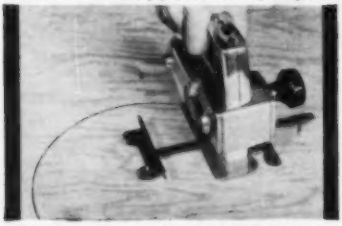

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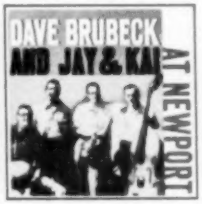

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